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ROYAL BOTANIC GARDENS, KEW.

BULLETIN

OF

MISCELLANEOUS INFORMATION.

1917.

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No. 1] [1917

I.—NOTES ON UGANDA FUNGI.

I.—The Fungus-Flora of the Forests.

T. D. Maitland and E. M. Wakefield.

During the past two years one of us has spent some considerable time collecting and observing the fungi which occur in the forests of Uganda. The collections thus made have been deposited at Kew, where they have been supplemented by other general collections of Uganda fungi due to the energies of Mr. W. Small, Botanist in the Agricultural Department, Uganda, and of Mr. R. Dummer. The species received now number some hundreds, and although far from exhausting the mycology of the region, they appear to be fairly representative of the types of fungus flora to be found, at any rate in the Uganda Province. It has therefore seemed advisable to place on record some of the knowledge which has been acquired, the more so because, as far as we are aware, the only list of Uganda fungi previously published is that of the collection made by Scott Elliot during the Ruwenzori expedition.*

The present account deals only with those fungi, chiefly the macro-forms, which occur as saprophytes in the forests. With the exception of the few species collected by Mr. Small on Mount Elgon, the fungi enumerated all come from forests lying in the eastern part of the Uganda Province. There are other large forests in the western district which have not been touched, but their fungi are probably not strikingly different from those of the forests visited.

Ecological Notes.

(T. D. Maitland.)

The first collections of fungi were made in several small forests lying within the Victoria Nyanza region, north-west of Lake Victoria Nyanza. The names of these forests are Wakigu, Namamvwe, Nabaziza, Ntongo, Bumpenge, and Namutambula.

* Miss A. L. Smith in Journ. of Bot. 33, 1895, p. 340.

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They lie in a semi-circle stretching from Jinja on the one hand to Entebbe on the other. It will be seen that their dispositions are not varied enough to provide extensive modifications in their vegetation, and that a description of one forest will serve for them all.

These forests, with the exception of Bumpenge, lie in valleys, and their growth is restricted to a certain area on the incline, their vegetation ceasing abruptly at the margin of the grassy land surrounding them. Each of them, including the lower region of Bumpenge, possesses a small rivulet, which eventually finds its way into the Great Lake. It is usual also to find small stretches of stagnant swamps.

Although the forests are not extensive, they contain some large timber trees which are exploited by the natives. The wild date palm (*Phoenix reclinata*) is dispersed in considerable numbers throughout these forests, as well as in the swamps and grassy lands surrounding them. The Bisu palm (*Raphia Monbuttorum*) is only sparsely distributed, but some very fine and majestic trees are to be seen. The decayed stumps of the various palms afford a good hunting ground for fungi, especially for species of *Ganoderma*.*

In each of the forests the undergrowth consists in some parts of a tangled mass of lianes and shrubby plants, in others of a short vegetation of *Scitamineae*, *Liliaceae*, and *Gramineae*.

The actual habitat of some of the fungi is striking. As already stated the larger species of *Ganoderma* occur almost always on dead palm stumps, but are by no means confined to the forests, for an abundance of these growths is found on palm stumps in farm clearings and plantations. The most conspicuous of the larger fungi of these regions belong to the *Polyporaceae*. They are found principally on loose fallen branches, in many instances lying on the top of the undergrowth. *Polyporus gilvus*, however, is usually, if not always, found on much decayed fallen tree trunks in shady positions. *Polystictus occidentalis*, a common fungus, is another exception, as when found in the forest it is usually in open airy places. Most of the specimens of this species were gathered in the open country and invariably on smooth-barked trees, such as Albizzias. *Polystictus sanguineus* is, one may safely say, confined to clearings and plantations, and invariably grows on the dead trunks of *Phoenix reclinata*.

There are not many striking types of *Agaricaceae* to be found, though numerous "flushes" of small species are to be seen on thoroughly rotted tree trunks in humid and densely shaded situations. Species of *Marasmius* are occasionally seen, and tangled masses of a "Horse-hair" fungus are met with amongst decayed branches of the undergrowth.

The larger *Sphaeriaceae* are well represented, and are usually found on fallen, well-decayed tree trunks in damp and shady situations. *Xylaria grammica*, *X. polymorpha*, and *Tham-*

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* The same fact has been noted in Nigeria by Mr. C. O. Farquharson. (See *Kew Bull.* 1914, p. 254, and Journ. of Bot. 54, No. 641, May, 1916, p. 123.)

nomyces Chamissonis are common under these conditions. They appear to be almost entirely confined to the heart-wood of dead trees, and especially hard-wooded trees, as in many cases it is well-nigh impossible to cut specimens out.

On the other hand *Hexagonia discopoda, Stereum lobatum Hymenochaete* spp. etc., prefer the bark of dead branches, while other species thrive on decayed outer wood, and yet others, as *Polystictus luteo-nitidus*, on leaf-mould. It would appear that certain fungi are suited to certain stages in the decay of wood.

The second series of forests visited run along the northern boundary of the Mawokota District. They commence at about mile 16 on the Kampala-Mubendi Road, and continue to about mile 26, but here deviate somewhat from the main road. The sections visited are known as Balisangakibugo, Tiriulire, Mwengizanyagi, Nakatumba, and Nakinyika, and are drained by the Mayanja and its tributaries which flow north and north-west of the Great Lake into the river Kafu.

These forests are perhaps the most striking within easy reach of Kampala, and, like most Buganda forests, nestle in a series of valleys, the afforestation being restricted to a certain area on the slopes of these valleys.

In general character they do not vary to any considerable extent from those strictly in the Victoria Nyanza region. The same undergrowth is met with—*Dracaena*, *Amomum*, *Cyperus*, lianes, and in parts a low shrub. This undergrowth is, generally speaking, not difficult to penetrate, and only when nearing the outskirts of the forest is a more tangled and denser vegetation encountered. This consists first of a thick shrubby growth, then of a mixture of Elephant Grass (*Pennisetum purpureum*), prickly *Solanums*, *Convolvulus* spp., and *Cucurbitaceae*. *Musa ensete* is also fairly common.

The forest trees are, if anything, more striking here than in the other series of forests visited. The tall white-barked trees with *Usnea*-like lichens hanging from their branches are very beautiful; likewise the giant "Mwafu," *Canarium Schweinfurthii*, with its massive arms laden with the Bird's Nest fern (*Asplenium Nidus*), *Platycerium* sp., Polypodiums, and Orchids. *Phoenix reclinata* enjoys a wide distribution both in the surrounding country and in these forests.

The fungus-flora is more or less identical with that of the forests in Kiagwe and Busiro, round the lake, since the forests are in most respects alike. Of the *Polyporaceae* the most abundant representative seen was *Polystictus aratus*. This species was plentiful on stout fallen branches and on dead branches still adhering to the tree. *Stereum lobatum* was widely dispersed, and the forms here were larger than any previously gathered. Species of *Xylaria* were also very numerous, including some very stout forms of *X. grammica*. The following fungi were also found to be widely distributed throughout these parts:—*Ganoderma lucidum*, *G. australe*, *Polystictus luteo-nitidus*, *P. flabelliformis*, *P. funalis*, *P. vinosus*, *Polyporus gilvus*, *Stereum Schomburgkii*, *Lenzites repanda*, *Lentinus infundibuliformis*, *Hydnum*, *Laschia* and *Marasmius* spp.

Nabuvumba Forest, in Busiro district, in many respects resembles Nakinyika Forest, in Mawokota, both being for the most part humid and swampy. An outstanding feature of Nakinyika Forest is the numerous Landolphias and fine large trees of *Canarium Schweinfurthii*.

In Bulimezi, Kangavwe Forest is rather remarkable for the huge boulders dispersed throughout, many of them moss-covered. Not many fungi of a striking character were met with there, *Fomes rimosus* being the most outstanding. In addition to those sent, *Stereum Schomburgkii*, *Polystictus obstinatus* on the edge of the forest, *Laschia Volkensii*, and several Agarics were observed. This forest covers the top of Kangavwe Hill (1274 m.) in lat. 0·35° and long. 32·20°. The dry aspect in all probability accounts for the paucity of fungi as compared with the forests in the valleys.

The Mabira Forests, visited in September, 1915, lie within the Nile and Sezibwa River watersheds on the left bank of the Nile, and about 15 miles from the Ripon Falls, where the Nile leaves the Great Lake. They extend north to the great Sezibwa Swamp and cover an area of about 137 square miles.

Although of the same type as the forests scattered throughout the Buganda Kingdom, they are on a very much larger scale, and cover hill and dale, instead of being confined to the valleys. One outstanding feature of these forests, as compared with most others, is the wide distribution of the rubber tree *Funtumia elastica*, Stapf—a feature which has made them famous, in addition to the exploitation of the large and valuable timber trees.

Although large, these forests can be traversed with comparative ease, for the undergrowth—except where some large trees have been felled and have thus given it the advantage—is not sufficiently thick to necessitate cutting a way through. Dracaenas form a large part of the undergrowth, and also young seedling forest trees and lianes. Numerous paths made by animals ramify through the forest.

The climatic conditions of this large forest area differ from those of the surrounding country. The rainfall is greater and the humidity higher. Hence, with the fallen trees and branches and other decaying vegetation, conditions are very favourable for the development of a rich fungus-flora.

About 28 miles of the forest were traversed and many specimens collected which were not represented in the gatherings from other forests. Speaking generally, however, the fungus-flora is very similar to that found throughout the Victoria Nyanza Region. *Fomes rimosus* was collected here, for the first time in the Victoria Nyanza Region, and was well represented. It was found in low-lying, humid places, contrasting with its habitat in the high and dry Kangavwe Forest in Bulimezi. *Lenzites repanda* is perhaps the most abundant species, and is not confined to the forests, for it occurs abundantly on dead stumps in clearings and plantations on the outskirts. *Trametes corrugata* is also very common, but confined to the more open parts rather than to the interior. Only one specimen of *Fomes hornodermus* was found, on a live tree six feet up the trunk, but

apparently not parasitic. *Fomes pectinatus* appears to prefer lianes, occurring on both live and dead bark and roots.

Most of the forests are more or less humid at all times of the year. Agarics are perhaps slightly more in evidence in the rainy season, but on the whole the types of fungi to be met with are the same at all seasons.

Systematic List.

(E. M. Wakefield.)

Agaricaceae.

Lentinus strigosus, *Fr.* Elench. I, p. 47.
Mabira Forests, *Maitland* M 5, not common; Kampala, *Small.*

Lentinus villosus, *Kl.* in Linnaea VIII, 1833, p. 479.
Mabira Forests, *Maitland* M 9.

Lentinus velutinus, *Fr.* in Linnaea V, 1830, p. 510.
Mabira Forests, *C. B. Ussher* 55, 1908.

Lentinus blepharodes, *Berk. et Curt.* in Journ. Linn. Soc. X, 1869, p. 301.
Wakigu Forest, *Maitland* 7A; Kipayo, *Drummer* 1425; *Mabira* Forests, *Maitland* M 10.

Lentinus infundibuliformis, *Berk. et Br.* in Journ. Linn. Soc. XIV, 1873, p. 42.
Victoria Nyanza region, *Maitland* 58; Balisangakibugo Forest, *Maitland* 185 A; Mawokota, *Small* 252; Mabira Forests, according to Maitland fairly common on dead stumps.
These African specimens do not quite conform to the Ceylon type. They have a coarser appearance and a more strigose surface of the pileus, but do not appear to be specifically distinct.

Lentinus exilis, *Kl.* ex *Berk.* in Ann. and Mag. Nat. Hist. III, 1839, p. 379.
Kipayo, *Dummer* 645, 1420; Mabira Forests, *Maitland* M 12, M 13 (the latter approaching *L. dactyliophorus*).

L. dactyliophorus, *Lév.* in Ann. sci. nat. sér. 3, vol. 2, 1844, p. 174.
Kampala, *Small* 80.
Probably only a form of *L. exilis*, distinguished by its smaller size, deeply infundibuliform shape, and more distinct ring.

Lenzites repanda, *Fr.* Epicr. p. 404.
Common everywhere. Kampala, *Small* 56; *Dummer* 944, 2530; Victoria Nyanza region, *Maitland* 53, 60; Mubendi Road Forests, Mawokota, *Maitland.*

Schizophyllum commune, *Fr.* Syst. Myc. I, p. 333.
Common, *Maitland* 29, *Small* 132, *Dummer* 157.

Polyporaceae.

Polyporus picipes, *Fr.* Epicr. p. 440.
Kipayo, *Dummer* 2110; Kampala, *Maitland;* Mabira Forests, *Maitland* M 8.
All these specimens have slightly larger pores than the typical form of the species.

P. dictyopus, *Mont.* in Ann. sci. nat. sér. 2, vol. 3, 1835, p. 349.
Kipayo, *Dummer* 2111.

P. megaloporus, *Mont.* in Ann. sci. nat. sér. 4, vol. 1, 1854, p. 124.
Nakinyika Forest, *Maitland* 131.

P. cinnamomeo-squamulosus, *P. Henn.* in Engl. Bot. Jahrb. 30, 1901, p. 43.
Nakinyika Forest, *Maitland* 132; Mabira Forests, *Maitland* M 26 (fairly common).

P. gilvus (*Schw.*) *Fr.* Elench. I, p. 104.
Kipayo, *Dummer* 1145; Victoria Nyanza region, *Maitland;* Mubendi Road Forests, Mawokota, *Maitland;* Mabira Forests, *Maitland.*

P. anebus, *Berk.* in Hook. Lond. Journ. Bot. 1847, p. 504.
Balisangakibugo Forest, *Maitland* 182.

P. pubertatis, *Lloyd,* Syn. Sect. Apus of Polyporus, 1915, p. 358.
Balisangakibugo Forest, *Maitland* 168, rare.
The single specimen sent agrees with the Japanese species in texture, colour of the flesh, spores, etc. It is, however, much larger than the type, more applanate, and with a more irregular, tubercular surface of the pileus.

Amauroderma sericatum, *Lloyd,* Syn. Stipit. Polyp., 1912, p. 120.
Kampala, *Maitland;* Nabaziza Forest, *Maitland* 4; Kipayo, *Dummer* 2144.
This plant grows on the ground in very shady places, and is usually gregarious. It is more slender than *A. rugosum,* and is distinguished microscopically by the smooth spores and by the presence of stout brown hyphae in the pore walls. At the mouths of the pores the pointed ends of these hyphae almost form projecting setae. In the Uganda specimens the pileus is usually more zoned and less uniformly silky than in the type, but the other characters agree.

Ganoderma australe (*Fr.*) *Pat.* in Bull. Soc. Myc. Fr. 1889, p. 71.
Kipayo, *Dummer* 908; Kampala, *Small* 317, 318; Mabira Forests, common, *Maitland.*

Ganoderma lucidum (*Leys.*) *Karst.* in Rev. Myc. 1881, No. 9, p. 17.

Common everywhere. Kampala, *Small* 70, 320, 319 (yellow form), *Dummer* 644; Victoria Nyanza region, *Maitland* 47; Namutambula Forest, *Maitland* 12A; Nambeya, Bulimezi, *Maitland*, 154; Mubendi Road Forests, Mawokota, and Mabira Forests, *Maitland*.

G. mastoporum, (*Lév.*) *Pat.* in Bull. Soc. Myc. Fr. 1889, p. 71.

Kipayo, *Dummer* 643.

G. fornicatum (*Fr.*) *Pat.* in Bull. Soc. Myc. Fr. 1889, p. 71.
Wakigu Forest, *Maitland* 207.

Fomes senex (*Nees et Mont.*) *Fr.* Nov. Symb. p. 62.
Kampala, *Small* 248; Mubendi Road Forests, *Maitland*.

F. pectinatus (*Kl.*) *Fr.* Nov. Symb. p. 66.

Nabaziza Forest, *Maitland* 8A, on a living liane, near the base, and also on a dead stump; Nabuvumba Forest, *Maitland* 150, on a living liane, $2\frac{1}{2}$ to 3 feet from the ground, the stem being to all appearance quite healthy.

F. rimosus (*Berk.*) *Fr.* Nov. Symb. p. 66.

Kangavwe Forest, Bulimezi, *Maitland* 115; Mabira Forests, *Maitland*, on living and dead trunks.

"In Kangavwe Forest this was the most conspicuous fungus, and fairly common. It was found on dead erect trees and also on living trees, growing on the trunks at varying heights up to about 12 feet high. The scar left on the living tree when the fungus was broken off was to all appearance quite healthy, and no sign of blackening or disease was observable. The trees on which they were found had corky bark." (T. D. M.)

F. melanoporus (*Mont.*) *Fr.* Nov. Symb. p. 65.

Kipayo, *Dummer* 1465; Wakigu Forest, *Maitland* 84, 94; Balisangakibugo Forest, *Maitland* 178.

Numbers 94 and 178 are resupinate forms of the species.

F. caliginosus (*Berk.*) *Cooke* in Grevillea XIV, 1885, p. 20.

Namutambula Forest, *Maitland* 2; Wakigu Forest, *Maitland* 108; Kipayo, *Dummer* 2156A.

F. geotropus, *Cooke* in Grevillea XIII, 1884, p. 32.
Nambeya Forest, *Maitland* 109.

F. hornodermus (*Mont.*) *Cooke* in Grevillea XIII. 1885, p. 119.

Mabira Forests, *Maitland* M 36, on a living tree, 6 feet up the trunk, but the tree apparently quite healthy.

Polystictus luteo-nitidus (*Berk.*) *Cooke* in Grevillea XIV, 1886, p. 77.

Among leaf-mould, or attached to roots and twigs; Victoria

Nyanza region, *Maitland* 73 (unusually large and regular forms): Nakatumba Forest, *Maitland;* Kipayo, *Dummer* 2529.

Polystictus xanthopus, *Fr.* Nov. Symb. p. 74.
Kipayo, *Dummer* 624, 1179; Victoria Nyanza region, *Maitland* 57; Mabira Forests, *Maitland*, fairly common.

P. flabelliformis (*Kl.*) *Fr.* Nov. Symb. p. 74.
Kipayo, *Dummer* 905; Victoria Nyanza region and Mabira Forests, common, *Maitland* 45; Mubendi Road Forests, Mawokota, *Maitland.*

P. sanguineus, *Fr.* Nov. Symb. p. 75.
Very common, especially on dead trunks of *Phoenix reclinata.* It occurs rather in the open, in clearings and plantations, than in the forests themselves. *Small, Maitland,* various collections.

P. mutabilis (*Berk. et Curt.*) *Cooke* in Grevillea XIV, 1886, p. 78.
Victoria Nyanza region, *Maitland* 75; Namutambula Forest, *Maitland* 28A; Mawokota, *Small* 158.
The Uganda forms are not quite typical. They have a thicker and more rugulose pileus than usual, and rather larger pores.

P. vernicipes (*Berk.*) *Cooke* in Grevillea XIV, 1886, p. 78.
Namutambula Forest, *Maitland* 29A.

P. chrysites (*Berk.*) *Cooke* in Grevillea XIV, 1886, p. 82.
Kampala, *Small* 59.
Some very fine thick specimens. In one case a number of pilei have grown together to form a large bracket.

P. Proteus (*Berk.*) *Fr.* Nov. Symb. p. 79.
Kampala, *Small.*

P. pinsitus, *Fr.* Nov. Symb. p. 88.
Victoria Nyanza region, *Maitland* 63; Balisangakibugo Forest, *Maitland* 169.

P. versicolor (*Linn.*) *Fr.* Nov. Symb. p. 86.
Kampala, *Small* 51.

P. hirsutus, *Fr.* Nov. Symb. p. 86.
Kipayo, *Dummer* 2122; Mount Elgon, 1680 m., *Small* 175; Mabira Forests, *Maitland.*

P. obstinatus, *Cooke* in Grevillea XIV, 1886, p. 83.
Trametes obstinatus, Cooke in Grevillea XII, 1883, p. 17.
Namamvwe Forest, Victoria Nyanza region, *Maitland* 50; Balisangakibugo Forest, *Maitland*; Kangavwe Forest, Bulimezi, *Maitland;* Mabira Forests, very common in clearings, *Maitland.*

P. vittatus (*Berk.*) *Fr.* Nov. Symb. p. 86.
Kampala, on dead stumps in the open, *Maitland* 5, *Small* 52.

Polystictus vinosus (*Berk.*) Sacc. Syll. VI, p. 273.
Kampala, *Small* 66; Kipayo, *Dummer* 1130; Namutambula Forest, *Maitland* 10A; Wakigu Forest, *Maitland* 83, Namamvwe Forest, *Maitland* 189, 190.

P. occidentalis (*Kl.*) *Fr.* Nov. Symb. p. 90.
Victoria Nyanza region, *Maitland* 46, 51; Mount Elgon, 1680 m., *Small* 176; Mabira Forests, very common in clearings, *Maitland*.

P. lanatus, *Fr.* Nov. Symb. p. 90.
Kampala, *Small* 72.

P. aratus (*Berk.*) *Cooke* in Grevillea XIV, p. 86.
Polyporus luteo-olivaceus, Berk. et Br. in Trans. Linn. Soc., 2 ser., I, 1880, p. 402.
Very common everywhere. Victoria Nyanza region, *Maitland* 66; Bumpenge and Namutambula Forests, *Maitland* 3A, 16A; Wakigu Forest, *Maitland* 92; Balisangakibugo Forest, *Maitland* 167A; Nakinyika Forest, *Maitland* 125A; Kangavwe Forest, Bulimezi, *Maitland* 125; Namamvwe Forest, *Maitland* 167B; Kipayo, *Dummer* 907; Kasala Forest, *Dummer* 2360; Kampala, *Small* 67, 73, 75; Mabira Forests, *Maitland*.
The species is as variable as it is common. When young the pileus is rather rigid, the pores regular, and covered with a glaucous bloom. In old specimens, however, the pileus becomes more flexible, being frequently much eaten by insects, the pores become longer and the openings irregular, while the glaucous deposit disappears, leaving the hymenium of a dark olive-brown colour. Stalked forms are not infrequent, the stalk being in some cases as much as 2 in. long.

P. caperatus (*Berk.*) *Fr.* Nov. Symb. p. 92.
Wakigu Forest, *Maitland* 91, 93, 98, 101; Bumpenge Forest, *Maitland* 107; Mabira Forests, *Maitland* M 28.
The specimens vary very greatly in size and thickness, and also in the development of the tomentum of the pileus. The following species appears to be probably only a form with larger and more irregular pores.

P. Fischeri, *P. Henn.* in Engl. Bot. Jahrb. 23, 1897, p. 546.
Wakigu Forest, *Maitland* 90, 100; Kipayo, *Dummer* 2117.

P. tabacinus (*Mont.*) *Fr.* Nov. Symb. p. 93.
Nabuvumba Forest, *Maitland* 148.

P. beharensis (*Berk.*) *Cooke* in Grevillea XIV, 1886, p. 87.
Mubendi Road, Kampala, *Maitland* 146.

Trametes corrugata (*Pers.*) *Bres.* in Hedwigia, vol. 51, 1912, p. 316.
Polystictus Persoonii, Fr. ex *Cooke* in Grevillea XIV, 1886, p. 85.
Victoria Nyanza region, *Maitland* 52; Mabira Forests, common

on dead stumps in the open, *Maitland;* Kampala, *Small*, *Maitland;* Nambeya Forest, *Maitland.*

It is curious that the Uganda forms are all very thick, some of them being almost hoof-shaped. They are, moreover, for the most part entirely white, though the characteristic dark red stain was observed at the base of the pileus in a few instances. The usual thin form with a well-developed, reddish pileus does not appear, however, to occur in this region.

Trametes cingulata, *Berk.* in Hook. Journ. Bot. 1854, p. 164.
Kipayo, *Dummer* 2531.

Hexagonia Miquelii (*Mont.*) *Sacc.* Syll. VI, p. 361.
Victoria Nyanza region, *Maitland* 72, pro parte; Mukono Forest, rare, *Dummer* 2354; Kipayo, rare, *Dummer* 2523; Mabira Forests, sparsely distributed, *Maitland.*

H. discopoda, *Pat. et Har.* in Bull. Soc. Myc. Fr. IX, 1893, p. 209.
Kampala, *Small* 74; Kipayo, *Dummer* 1142; Victoria Nyanza region, *Maitland* 74A; Mount Elgon, 1525 m., *Small* 162; Mabira Forests, sparsely distributed, *Maitland.*
The species is not aptly named, for it is more frequently sessile than stipitate. It is common in tropical Africa, and easily recognised by the dark reddish stain at the base of the pileus.

H. velutina, *Pat. et Har.* in Bull. Soc. Myc. Fr. IX, 1893, p. 209.
Kipayo, *Dummer* 904; Mabira Forests, common on dead tree trunks and stumps, *Maitland.*

H. atro-sanguinea, *P. Henn.* in Engl. Bot. Jahrb. 23, 1897, p. 545.
Nabaziza Forest, *Maitland* 25A; Kipayo, *Dummer* 2367.

Favolus brasiliensis, *Fr.* Elench. I, p. 44.
Victoria Nyanza region, *Maitland* 36; Mount Elgon, 1370 m., on the dead wood of a bridge, *Small* 177; Kabulamuliro, Singo, on dead branches of *Phoenix reclinata* in the open, *Maitland* 121.

Laschia Volkensii, *Bres.* apud *Henn.* in Engler, Pflanzenwelt Ostafrikas, Teil C, p. 58.
Victoria Nyanza region, *Maitland* 79; Mawokota, *Small* 156. 255; Bumpenge Forest, *Maitland* 32A; Kangavwe Forest, Bulimezi, *Maitland;* Mabira Forests, common, *Maitland.*

Hydnaceae.

Hydnum reniforme, *Berk. et Curt.* in Journ. Linn. Soc. X, 1869, p. 325.
Wakigu Forest, *Maitland* 105.

Hydnum glabrescens, *Berk. et Rav.* in Grevillea, I, 1873, p. 97, and in Journ. Linn. Soc. XIV, 1873, p. 59.
Victoria Nyanza region, *Maitland* 77; Mubendi road Forests, *Maitland.*

H. cinnabarinum (*Schw.*) *Fr.*, Elench. p. 137.
Kipayo, *Dummer* 622.
This may be only a state of *Polystictus sanguineus*, but the form is quite worthy of record. The habit is exactly that of a resupinate *Hydnum* (*Acia*).

Irpex durescens (*Cooke*) *Sacc.* Syll. VI, p. 485.
Wakigu Forest, *Maitland* 85; Nabaziza Forest, *Maitland* 209; Kijude, *Dummer* 2522.

I. flavus, *Kl.* in Linnaea VIII, 1833, p. 488.
Kipayo, *Dummer* 2139.

Grandinia rosea, *P. Henn.* in Engl. Bot. Jahrb. 38, 1905, p. 108.
Wakigu Forest, *Maitland* 89.

Caldesiella Duemmeri, *Wakefield,* in Kew Bull. No. 3, 1916, p. 73.
Kipayo, *Dummer* 635.

Mucronella calva, *Fr.* Hym. Eur. p. 629.
Kipayo, *Dummer* 1172.

THELEPHORACEAE.

Cladoderris infundibuliformis (*Kl.*) *Fr.* Fung. Natal. p. 141.
Namutambula Forest, on a decayed stump of *Phoenix reclinata*, *Maitland* 1; Nabaziza Forest, *Maitland* 30A; Kipayo, *Dummer* 2108; Mabira Forests, not very abundant, usually on thick fallen branches, *Maitland.*

Cyphella fulvo-disca, *Cooke et Mass.* in Grevillea XVIII, 1890, p. 50, and in Hedwigia 29, 1890, p. 67.
Kipayo, *Dummer* 1157.

Stereum elegans (*Mey.*) *Fr.* Epicr. p. 545.
Kipayo, *Dummer* 2300; Mawokota, *Small* 253; Mabira Forests, on a dead stump which had rotted to the ground level, *Maitland* M2.

S. affine, *Lév.* in Ann. sci. nat. sér. 3, 2, 1844, p. 210.
Mawokota, *Small* 257; Kipayo, *Dummer* 626.

S. nitidulum, *Berk.* in Hook. Journ. Bot. 1843, p. 638.
Victoria Nyanza region, *Maitland* 80.

Stereum involutum, *Kl.* ex *Fr.* Epicr. p. 546.
Bumpenge Forest, on dead branches in an open part of the forest, *Maitland* 33A.

S. australe, *Lloyd*, Letter No. 48, 1913, p. 10.
Wakigu Forest, *Maitland* 151; Kipayo, *Dummer* 906.

S. bicolor (*Pers.*) *Fr.* Epicr. p. 549.
Kampala, *Small* 57; Victoria Nyanza region, *Maitland* 37, 44, 82.

S. lobatum, *Fr.* Epicr. p. 547.
Kampala, *Small* 76; Victoria Nyanza region, *Maitland* 62; Kipayo, *Dummer* 624 (pro parte), 2310; Mubendi Road Forests, *Maitland* (very large specimens); Mabira Forests, common on thick dead branches, *Maitland*.

S. rimosum, *Berk.* in Hook. Journ. Bot. 1851, p. 169.
Nabaziza Forest, *Maitland* 19A.

S. Schomburgkii, *Berk.* in Journ. Linn. Soc. XIII, 1873, p. 168.
Kipayo, *Dummer* 945, 1133; Bumpenge Forest, *Maitland* 34A; Mubendi Road Forests, *Maitland;* Kangavwe Forest, Bulimezi, *Maitland;* Mabira Forests, *Maitland*.

S. annosum, *Berk. et Br.* in Journ. Linn. Soc. XIV, 1873, p. 67.
Nakinyika Forest, *Maitland* 127; Balisangakibugo Forest, *Maitland* 186.
This species is very closely allied to *S. frustulosum*, and might be considered as a variety of that plant, differing chiefly in the pileate habit. The best developed specimens are broadly effused, with a distinct reflexed pileus up to 2 cm. in width. The cystidia are like those of *S. frustulosum*, and the species differs from *S. subpileatum* in this character, as well as in the smooth pileus. The effect on the wood is similar to that of *S. frustulosum* and *S. subpileatum*.*

S. albo-cinctum, *Berk. et Br.* in Journ. Linn. Soc. XIV, 1873, p. 66.
Kipayo, *Dummer* 2114.
The species is near to *S. induratum*, Berk., but is entirely resupinate, whereas the type specimen of that species is pileate. Both *S. induratum* and *S. albo-cinctum* are distinguished from *S. duriusculum* by the thick, *cinnamon-brown* flesh.

S. umbrinum, *Berk. et Curt.* in Grevillea I, 1873, p. 164.
For synonymy see *Kew Bull.* No. 8, 1915, p. 369.
Kipayo, on *Sapium Mannianum*, *Dummer* 1159; Ntongo, Busiro, on a dead erect stump of *Phoenix reclinata*, *Maitland* 194, (a pale form).

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* Cfr. Long in Journ. Agr. Res. v. 1915, p. 421.

Hymenochaete luteo-badia (*Fr.*) *Wakefield*, comb. nov.
Stereum luteo-badium, Fr. Epicr. p. 547. *Thelephora Kunzeii*, Hook. in Bot. Misc. II, 1831, p. 163. *Hymenochaete Kunzeii*, Mass. in Journ. Linn. Soc. XXVII, 1890, p. 100.
Victoria Nyanza region, *Maitland* 71; Kipayo, *Dummer* 1452; Mabira Forests, *Maitland* M17.

H. cervina, *Berk. et Curt.* in Grevillea I, 1873, p. 165.
Mount Elgon, 1220 m., *Small* 227.

H. tristicula (*Berk. et Br.*) *Mass.* in Journ. Linn. Soc. XXVII, 1890, p. 111.
For synonymy see *Kew Bull.* No. 3, 1916, p. 73.
Very common on fallen twigs and branches. Victoria Nyanza region, *Maitland* 25; Kangavwe Forest, *Maitland* 119; Nakinyika Forest, *Maitland* 138; Mwengizanyagi Forest, Mawokota, *Maitland* 202; Mabira Forests, *Maitland* M30.

Peniophora cinerea (*Fr.*) *Cooke* in Grevillea VIII, 1879, p. 20.
Kampala, on the bark of *Acacia* sp., *Maitland* 198.

P. occidentalis, *Ell. et Ev.* in Bull. Torr. Bot. Cl. XXIV, 1897, p. 277.
Kangavwe Forest, Bulimezi, *Maitland* 114.
Cystidia large, thick-walled, pointed, encrusted with crystals in the upper part, sunken or emerging, up to 175 μ long, 20-30 μ wide. Spores cylindrical, 13-14 × 6 μ.

P. radicata (*P. Henn.*) *v. Hoehn. et Litsch.* in Sitzber. k. Akad. d. Wissensch. Wien, CXVII, 1, 1908, p. 1092.
Kipayo, *Dummer* 636.

Asterostromella sp.
Nakatumba Forest, *Maitland* 205.
The species is near to *A. investiens*, but darker in colour. The specimens are unfortunately sterile.

Clavariaceae.

Pterula importata, *P. Henn.* in Verh. Bot. Ver. Prov. Brandenb. XL, 1898, p. 121.
Kipayo, *Dummer* 1185.

Lachnocladium Zenkeri, *P. Henn.* in Engl. Bot. Jahrb. XXX, 1901, p. 42.
Kipayo, *Dummer* 929, 2146; Balisangakibugo Forest, *Maitland* 176.
The plant is white when young, but turns to a fleshy colour when old. It is common in most forests and at most times of the year (Maitland).

Tremellaceae.

Auricularia tremellosa (*Fr.*) *Petch* in Ann. Roy. Bot. Gard. Peradeniya. Vol. IV. 1910, p. 414. Cfr. also Patouillard in Journ. de Bot. I, 1887, p. 226.
Mount Elgon, 1220 m., *Small* 145.

Hirneola ampla (*Pers.*) *Fr.* Fung. Nat. p. 146.
Mubendi, 1220 m. *Small* 321.
This species is thinner, paler, and less woolly on the surface of the pileus than *H. polytricha*. The specimens are preserved in spirit and in that medium appear almost whitish.

H. polytricha (*Mont.*) *Fr.* Fung. Nat. p. 146.
Kipayo *Dummer* 1131; Victoria Nyanza region, *Maitland* 34; Mount Elgon, *Small* 146, 150, 157.

H. Auricula-Judae (*Linn.*) *Berk.* Outl. 1860, p. 289.
Kipayo, *Dummer* 613.

Tremella fuciformis, *Berk.* in Hook. Journ. Bot. 1856, p. 277.
Kipayo, *Dummer* 930.

T. mesenterica, *Retz.* in Vet. Akad. Handl. 1769, p. 249.
Mount Elgon, 1370 m. *Small* 144.

Guepinia spathularia (*Schw.*) *Fr.* Elench. II, p. 32.
Kipayo, *Dummer* 640; Kampala, on dead wood of *Phoenix reclinata*, *Small* 297, 301.

Calocera furcata, *Fr.* Syst. Myc. I, p. 486.
Kipayo, on dead stems of *Phoenix reclinata*, *Dummer* 1177.

Gasteromycetaceae.

Dictyophora indusiata, *Fischer* in Sarasin et Roux, Nova Caledonia, Vol. I, part 1, 1914, p. 3.
Nabuvumba Forest, the "egg" stage only, on a well-decayed stump in a very dark position, *Maitland* 153.

Cyathus limbatus, *Tul.* in Ann. sci. nat. sér. 3, vol. 1, 1844, p. 78.
Kipayo, *Dummer* 614.

C. Poeppigii, *Tul.* in Ann. sci. nat. sér. 3, vol. 1, 1844, p. 77.
Mount Elgon, 1370 m., *Small* 143; Kipayo, *Dummer* 2112.

Geaster mirabilis, *Mont.* in Ann. sci. nat. sér. 4, vol. 3, 1855, p. 139.
Kipayo, *Dummer* 1462.

G. velutinus, *Morg.* in Journ. Cinc. Nat. Hist. Soc. XVIII, 1895, p. 38.
Namamvwe Forest, *Maitland* 81; Kipayo, *Dummer* 1419, 1424.

Calvatia lilacina (*Mont. et Berk.*) *Lloyd,* Lycoperdaceae of Australia, 1905, p. 35.
Mabira Forests, *Maitland* M 38.

SPHAERIACEAE.

Gibbera guaranitica, *Speg.* Fung. guaran., Pug. 1, 1883, p. 91.

Mubendi Road Forests, *Maitland* 213; Kipayo, on dead stems of *Phoenix reclinata, Dummer* 2152.

Rosellinia emergens (*Berk. et Br.*) *Sacc.* Syll. I, p. 257.

Kampala, *Small* 62, 313; Mawokota, *Small* 164; Wakigu Forest, *Maitland* 208.

R. subiculata (*Schw.*) *Sacc.* Syll. I, p. 255.

Kampala, *Small* 78.

The spores are slightly smaller than in the type.

Xylaria polymorpha (*Pers.*) *Grev.* Flor. Edin. p. 35.

Victoria Nyanza region, *Maitland* 69; Mubendi Road Forests, Mawokota, *Maitland;* Kampala, *Small* 140, 308.

X. nigripes (*Kl.*) *Sacc.* Syll. IX, p. 527.

Kirerema, in a termite nest, sclerotia only, *Maitland* M 37.

X. grammica, *Mont.* in Ann. sci. nat. sér. 2, vol. 13, 1840, p. 341.

Victoria Nyanza region, *Maitland* 64, 67; Mawokota, *Small,* 159, 160, 161; Nabaziza Forest, *Maitland;* Mabira Forests, common, *Maitland.*

X. plebeja, *Ces.* Mycet. Born. 1879, p. 16.

Victoria Nyanza region, *Maitland* 27; Mawokota, *Small* 262.

X. anisopleura, *Mont.* in Ann. sci. nat. sér. 2, vol. 13, 1840, p. 348.

Kampala, *Small* 289; Kipayo, *Dummer* 1438.

X. involuta, *Kl.* ex *Cooke* in Grevillea XI, 1883, p. 82.

Kipayo. *Dummer* 2153; Mubendi Road Forests, *Maitland* 175.

X. Thwaitesii, *Berk. et Cooke* in Grevillea XII, 1883, p. 1.

Mabira Forests, *Maitland* M 21.

X. rhopaloides, *Mont.* in Ann. sci. nat. sér. 4, vol. 3, 1855, p. 99.

Victoria Nyanza region, *Maitland,* 33; Mawokota, *Small* 260.

X. pallida, *Berk. et Cooke* in Journ. Linn. Soc. XV, 1876, p. 395.

Nakinyika Forest, *Maitland* 135.

X. corniformis, *Fr.* Summ. Veg. Scand. p. 381.

Namamvwe Forest, *Maitland* 193.

X. Hypoxylon, *Grev.* Flor. Edin. p. 355.

Victoria Nyanza region, *Maitland* 32; Mubendi Road Forests, *Maitland* 119.

These specimens have slightly smaller spores than usual.

Xylaria Hypoxylon, forma tropica, *Theiss.* Xylariaceae Austro-brasil. 1909, p. 8.
Namamvwe Forest, *Maitland* 191.

X. flabelliformis (*Schw.*) *Berk. et Curt.* in Journ. Linn. Soc. X, 1869, p. 381.
Mawokota, *Small* 254; Kipayo, *Dummer* 2365.

X. arbuscula, *Sacc.* in Michelia I, 1878, p. 249.
Nagunga, *Dummer* 1439.

X. ianthino-velutina, *Mont.* in Ann. sci. nat. sér. 2, vol. 13. 1840, p. 348.
Nambeya Forest, *Maitland* 117, 118; Nakinyika Forest, *Maitland* 117A; Nakatumba Forest, *Maitland* 200; Mabira Forests. *Maitland* M 29.
The species is common in most of the forests visited, and always occurs on fallen seed-vessels.

X. Kurziana, *Currey* in Trans. Linn. Soc. ser. 2, 1, 1876, p. 129.
Victoria Nyanza region, *Maitland* 28.

Thamnomyces Chamissonis, *Ehrenb.* in Horae Physic. Berol. 1820, p. 79.
Victoria Nyanza region, *Maitland* 76; Kipayo, *Dummer* 2368; Mabira Forests, sparsely distributed, *Maitland.*

Camillea africana, *Wakefield* in Kew Bull. No. 3, 1916, p. 74.
Kampala, *Small* 137; Kipayo, *Dummer* 2364.

Ustulina zonata (*Lév.*) *Sacc.* Syll. I, p. 352.
Mount Elgon, *Small* 136, 215; Namamvwe Forest, *Maitland* 192; Kipayo, *Dummer* 1453.

Sarcoxylon aurantiacum, *Pat.* in Bull. Soc. Myc. Fr. 27, 1911, p. 331.
Balisangakibugo Forest, *Maitland* 195; Kipayo, *Dummer* 1443.

Daldinia concentrica, *Ces. et De Not.* in Comm. Soc. Critt. It. No. 4, 1863, p. 198.
Kampala, *Small* 55.

D. Eschscholtzii (*Ehrenb.*) *Rehm* in Ann. Myc. II, 1904, p. 175.
D. concentrica, var. *microspora* (Starb.) Theiss. in Ann. Myc. VII, 1907, p. 3.
Bumpenge Forest, *Maitland* 23A; Kipayo, *Dummer* 1442: Mabira Forests, common, *Maitland* M23.
The constant association of small spores with the conspicuous copper-coloured or purplish incrustation on the surface, and very light weight, appears to be a distinction worthy of specific rank.

Hypoxylon annulatum (*Schw.*) *Mont.* in Gay, Hist. de Chile, Bot. VII, 1850, p. 445.
Kangavwe Forest, Bulimezi, *Maitland* 112.

H. anthochroum, *Berk. et Br.* in Journ. Linn. Soc. XIV, 1873, p. 122.
Mubendi Road Forests, *Maitland* 145.

H. anthracodes (*Fr.*) *Sacc.* Syll. I, p. 365.
Nakinyika Forest, *Maitland* 124.

H. Malleolus, *Berk. et Rav.* in Grevillea IV, 1875, p. 49.
Wakigu Forest, *Maitland* 96; Kampala, *Small* 61; Mubendi Road Forests, *Maitland* 130.

H. microcarpum, *Penz. et Sacc.* in Malpighia XI, 1897, p. 492.
Nakinyika Forest, *Maitland* 126.

H. multiforme, *Fr.* Summ. Veg. Scand., p. 384.
Balisangakibugo Forest, *Maitland* 172; Mabira Forests, *Maitland* M 33.

H. quisquiliare, *Mont.* in Ann. sci. nat. sér. 2, vol. 14, 1840, p. 2, 321.
Kipayo, *Dummer* 2155.

H. rubiginosum, *Fr.* Summ. Veg. Scand., p. 384.
Kampala, *Small* 60; Kangavwe Forest, *Maitland* 113; Kipayo, *Dummer* 1449; Mabira Forests, *Maitland.*

H. stigmoideum, *Ces.* Mycet. Born. 1879, p. 17.
Victoria Nyanza region, *Maitland* 72 (pro parte).

Kretzschmaria cetrarioides (*Welw. et Curr.*) *Sacc.* Syll. IX, p. 567.
Mawokota, *Small* 163.

K. coenopus (*Mont.*) *Sacc.* Syll. IX, p. 565.
Kampala, *Small* 81; Victoria Nyanza region, *Maitland* 68.

Hypocreaceae.

Nectria ochroleuca (*Schw.*) *Berk.* in Grevillea IV, 1875, p. 16.
Kipayo, on decaying *Piptadenia africana, Dummer* 1431.

N. episphaeria (*Tode*) *Fr.* Summ. Veg. Scand. p. 388.
Mabira Forests, *Maitland* M 34.

N. Rickii, *Rehm,* in Hedwigia XLIV, 1904, p. 2.
Kipayo, *Dummer* 629, on *Ustulina zonata.*
This is a form with slightly longer spores, 7·5–8 × 4 μ. The same form, and on the same host, was collected by von Höhnel in Java. The species differs from *N. episphaeria* in the pale-coloured spores, with rough walls.

Nectria haematococca, *Berk. et Br.* in Journ. Linn. Soc. XIV, 1873, p. 116.
Mount Elgon, *Small* 134.

Hypocrea subcitrina, *Kalchbr. et Cooke* in Grevillea IX, 1880, p. 26.
Mubendi Road Forests, *Maitland* 143.

H. insignis,, *Berk. et Curt.* in Journ. Linn. Soc. X, 1869, p. 376.
Mabira Forests, *Maitland* M 22.
The spores are minute, hyaline, oblong or subglobose, 2 μ diam., or $2–2\frac{1}{2} \times 1\frac{1}{2}–2\ \mu$. A few asci with similar spores have been found in the type.

H. gelatinosa (*Tode*) *Fr.* Summ. Veg. Scand., p. 383.
Mabira Forests, *Maitland* M 4.

Hysteriaceae.

Tryblidiella rufula (*Spreng.*) *Sacc.*, Syll. II, p. 757.
Kipayo, on *Eugenia*, sp., *Dummer*, 1138.

Discomycetes.

Cookeina Colensoi (*Berk.*) *Seaver* in Mycologia V, 1913, p. 191.
Sarcoscypha Colensoi, Sacc. Syll. VIII, p. 157.
Geopyxis aluticolor, Sacc. Syll. VIII, p. 64.
Nakinyika Forest, *Maitland* 142.

Ciliaria scutellata (*Linn.*) *Boud.* in Bull. Soc. Myc. Fr. I, 1885, p. 105.
Kipayo, *Dummer* 1134.

Orbilia xanthostigma, *Fr.* Summ. Veg. Scand., p. 357.
Kipayo, *Dummer* 1136.

Hyphomycetes.

Trichoderma lignorum (*Tode*) *Harz* in Bull. Soc. Imper. Moscou, XLIV, 1871, part 1, p. 116.
Kampala, *Small* 131.

Trichothecium roseum (*Pers.*) *Link*, Observat. I, p. 18.
Kipayo, *Dummer* 1198.

Rhinotrichum Curtisii, *Berk.* in Grevillea III, 1875, p. 108.
Kasala Forest, *Dummer* 1418.

Helminthosporium gigasporum, *Berk. et Br.* in Journ. Linn. Soc. XIV, 1873, p. 98.
Mabira Forests. *Maitland* M 18.

Isaria Sphingum, *Schw.* Syn. Fung. Carol. 1822, p. 100.
Kipayo, on a moth, *Dummer* 1137.

I. congesta, *Berk. et Br.* in Journ. Linn. Soc. XIV, 1873, p. 96.
Kipayo, *Dummer* 1173; Mount Elgon, *Small* 240.

I. acervata, *Massee* in *Kew Bull.* 1901, p. 167.
Kipayo, *Dummer* 1175, 1429.

II.—SEED SELECTION IN THE CULTIVATION OF HEVEA BRASILIENSIS.

Clayton Beadle and Henry P. Stevens.

Our attention was recently drawn by the Director of the Royal Botanic Gardens, Kew, to the probable importance of seed selection in the cultivation of *Hevea brasiliensis*. He pointed out the large increase in the yield of alkaloids from cinchona bark which has been obtained as the result of seed selection, and suggested that important results might similarly be obtained in the cultivation of *Hevea brasiliensis*.

In June last we addressed a letter on this subject to the Rubber Growers' Association, which has been submitted to Messrs. Morgan, Marsden and Reeve, the Association's resident scientific officers in the East. We give below the substance of our original letter, together with a digest of their views:—

In the cultivation of cinchona the yield of quinine from the bark has been raised from about 3 per cent. to 7 per cent. or more as the result of planting from the seed of trees whose bark yielded a high percentage of alkaloids. Can a similar method of seed selection be applied to increase the yield of rubber?

The matter, however, is not so simple in the case of Para rubber as in the case of cinchona. In the latter, the analysis of the bark reveals the percentage of alkaloids, but in the case of Para rubber it would be necessary to keep daily records of the yields of individual trees over some considerable period before it could be said with certainty whether the trees were good or poor milkers. Work of this nature would have to be undertaken as a preliminary to seed selection, as there seems to be some doubt as to how far trees fluctuate in their yields over relatively long periods. We were informed by one planter of experience that a tree which was yielding poorly might be yielding well in a few months' time and, similarly, trees which appeared to be yielding large quantities of latex might, in the course of a few months, be found to be yielding quite small quantities. We have not had an opportunity of obtaining figures over a sufficiently long period.

Having ascertained definitely that trees vary in yield, it will then be necessary to devise means for selecting seeds from good milkers and avoiding those from poor milkers. This matter is more difficult in the case of a rubber tree than in the case of

cinchona. The cinchona produces a large number of small seeds, and consequently there is no difficulty in obtaining ample seed from a few trees, sufficient for planting up large areas. The bark gives a good yield of alkaloids when the tree is four years old and, although the percentage yield increases slowly over the next few years, the increase is small and regular, so that an examination of the bark of four-year-old trees is sufficient to determine their value as producers of alkaloids. On the other hand, *Hevea* produces a relatively small number of large seeds. Moreover, the bursting of the capsule by which these seeds become scattered makes it practically impossible to collect seeds from any particular tree*. There is also the question of cross-fertilisation, as, even if the seeds be taken from good milkers, they may have been pollinated from trees which are poor milkers.

The points which require elucidation are:—

1. To ascertain if trees can be classified as good and poor milkers.
2. To ascertain which trees are good milkers.
3. To collect seeds from particular trees.
4. To avoid cross-fertilisation between good and poor milkers.
5. Assuming that both male and female elements be derived from good milkers, there would probably be poor milkers among the ancestry. This would produce throw-backs, which might necessitate selection over another generation.

The necessary procedure would appear to be either:—

(*a*) To plant up a small area surrounded by jungle so as to isolate the trees in the area from those of the plantation, or:—

(*b*) To select a small area on an estate which is separate from other parts of the estate, and proceed to keep a record of the daily yields of the dry rubber from the trees of this area. As it becomes apparent that certain of these trees are poor milkers, they should be cut out until eventually the trees on this area consist of good milkers only.

If, as under (*a*), the trees have to be planted up on a fresh area, it will be seven or eight years before the poor milkers can be eradicated. If, however, an area already planted up should be found sufficiently isolated from the main part of the plantation to prevent the possibility of cross-fertilisation, a couple of years would probably suffice to ascertain which are the poor milkers and to cut them out.

The seeds now produced in this area will be entirely from good milkers. They will produce trees, the majority of which will be good milkers, although a few of them, in accordance with (5), may be throw-backs, and consequently poor milkers. However, the seeds from this area should be a vast improvement on seeds collected at random on an estate. Having carried the procedure so far, it would be well worth while to make a further selection by planting up a new area separated by a broad jungle belt from other *Hevea* trees, and again to proceed regularly to record the

* This difficulty might be overcome by cutting of seed-bearing branches just before the seed is fully ripe.

yields, eventually cutting out the poor milkers that will probably be found among them. In this manner seeds will be available which should produce practically nothing but good milkers.

There is, perhaps, an alternative to the first part of the procedure we have outlined, namely, the propagation of trees by means of cuttings. This is possible, and if found practicable the small area to be planted up for seed production could be furnished with good milkers grown directly from cuttings from the best milkers on the plantation.

The preliminary work carried out to distinguish between good and poor milkers may result in some simpler means being discovered by which either may be recognised. The investigation would be well worth undertaking from this point of view alone, as it would be of much benefit by enabling poor milkers to be cut out in the process of thinning out.

The matter, however, is one on which advice should be obtained from your botanists. We cannot profess to more than a general idea of the problem involved and the methods to be employed. We have, however, thought it worth while to bring the matter to your notice as we consider it to be of prime importance to the industry.

It is to be regretted that research of this description was not undertaken years ago by the Government Agricultural Departments in Ceylon or Malaya, as an ample supply of the best strain of seed would now have been available for planting purposes.

It should also be noted that deterioration in latex yields from newly-planted areas as compared with older areas is not only possible but, regarded from some standpoints, even probable. Thus, it is found that the cinchona trees which yield the smallest proportion of alkaloids from their bark produce abundance of seed, while exactly those trees which give the highest percentage of alkaloids are shy of fruiting. If it is possible to draw the parallel conclusion in the case of rubber trees, it follows that the present method of seed selection must result in a gradual deterioration of the rubber-yielding capacity of the tree for, by taking the seeds at random, a larger proportion of seeds from the prolific fruiting trees will be obtained, and these trees are just those which may be the poorest milkers.

Having now reviewed the matter, we will consider the various points in the order in which they have been raised:—

(1) To ascertain if there is an appreciable variation in the yields of individual trees over long periods. Messrs. Morgan and Marsden are agreed that no attempt has been made to obtain reliable data as to the variation in yield of latex and rubber from individual trees, nor is anything known for certain as to the regularity in yield over a long period. Mr. Morgan writes: "All planters are fairly sure that some trees are better yielders than others at all times," but also agrees that "yields may fluctuate." Mr. Marsden is also of the opinion that certain trees "do yield well consistently whilst from others the flow is always scanty." Both Messrs. Morgan and Marsden draw attention to

the occasional heavy yields from individual trees and suggest that such yields may be due to disease, especially canker, which, according to Mr. Marsden, in the early stages of attack stimulates the latex flow. In any series of experiments it is therefore necessary to examine the trees carefully to see that they are healthy.

(2) It being admitted that a variation exists to determine how a classification of good and poor milkers can be made. Mr. Marsden states that good milking trees are known, but that for strict work it would be best to take the quantity and quality of latex figures for at least a year. It is certain that planters believe they can distinguish between good and poor milkers as on this depends the selection of trees in thinning out. Mr. Marsden states that good milkers are characterised by "(1) fewness of seed pods, and (2) late wintering." If this be so, there would appear to exist the same relationship between yields of rubber and seed in *Hevea* as has been found to exist between yields of alkaloid and seed in *Cinchona*, and the same conclusion must apply, that is to say, with the present haphazard system there will be a tendency for the rubber-yielding capacity of the tree to diminish, but that by careful seed selection, it should be possible to raise the rubber-yielding capacity considerably above the present average level.

Mr. Morgan also refers to trees with a smooth bark of a pink shade which are said to yield better than trees with ordinary bark. These trees are found growing in patches.

(3) The collection of seeds from particular trees. Mr. Marsden considers that this might be done by putting bird netting over the capsules on one or two branches. Owing, however, to the prevalence of pod disease (due to *Phytophthora Faberi*, see later) in Ceylon, it has been impossible to collect really healthy seeds during the last few years. This disease could be kept in check by continuous spraying over a small area intended for seed collection.

With further reference to the question of seed selection Mr. Reeve has written the following report on the two points raised, i.e.—

(4) To avoid cross-fertilisation.

(5) Assuming that both male and female elements be derived from good milkers, there would probably be poor milkers among the ancestry. This would produce throw-backs in accordance with Mendel's law which might necessitate selection over another generation.

(4) *To Avoid Cross-fertilisation.*—This difficulty could be overcome by taking cuttings in the first generation. A tree known as a good milker could be lopped and the cuttings planted in some out-of-the-way place away from other rubber trees preferably with a belt of jungle around. From these cuttings seeds would have to be saved and planted. Allowing 5-6 years in Ceylon for the trees to come into bearing, the good milkers could be picked from the bad and all the poor ones cut out. It would be necessary then to obtain seeds from the best milkers and plant separate plots from each tree's seed. When these plots come into bearing that with the least number of poor milkers could be taken as the purest strain, and from this plot after cutting out

poor milkers the seed could be saved, knowing that such seed will give on an average 50 to 60 per cent. perhaps more of good milkers. New areas would need to be planted fairly thickly, and all poor milkers could then be cut out leaving, say, 100 trees per acre known to be good milkers.

Re the point raised as to Mendelism. Is it definitely known that the property of yielding an excessive quantity of latex is capable of inheritance as a Mendelian character? If this were so the establishment of a pure race of good milkers would be comparatively simple. Consider the simplest case of Mendelian inheritance, i.e., a cross between a pure bred good milker and a pure bred bad one. The first generation would be good or poor milkers according to the dominance of the latex-giving characteristic, i.e., if the good milker were dominant, a hybrid of fairly good milkers would result. From the impure hybrids on fertilisation pure strains and hybrids would result, and it would be necessary to pick out the pure strains and breed from them.

Probably nothing so simple would occur, and as Dr. Stevens suggests, there would almost certainly be a certain amount of bad milking strain in the ancestry which would have to be eliminated by breeding.

Even if the good milking characteristic did not follow Mendel's law it would probably be an inheritable fluctuation which by selection could be improved.

Rubber trees might also have been selected from a known good milker giving, say, 8 lbs. dry rubber per annum at 12 years old with the average yield per tree at 6 lbs. per annum and a breed of rubber trees could have been obtained giving on an average say 7½ lbs. per tree per annum, thus increasing yields 25 per cent. Such a procedure would have been the correct one, and a fairly pure strain of good yields could have been obtained in any 20 years starting from the good yielding tree in bearing. Such experiments could have been carried on indefinitely until a pure strain of good yielders were obtained.

Such a procedure is impossible now, and all that can be done is to select seeds from good yielders; if fresh planting is to be done, plant thickly and thin out poor yielders where necessary. Taking a widely planted area, say 60 trees per acre, I think fully 75 per cent. of the seeds would be fertilised from the pollen of the seed bearer, and only about 25 per cent. cross-fertilised from other trees, since an insect once it arrives at a tree stays, and does not give itself an unnecessary amount of flying. Such an area of older trees with all bad milkers thinned out would give a fairly pure strain of good milkers.

Such a seed-bearing area would, however, need continuous spraying during the S.W. monsoon in order to keep it free from attacks of pod disease (*Phytophthora Faberi*).* The ordinary rubber areas are full of this disease, and I do not think more than 1 per cent. of the seeds can be considered as good and plump and fit for planting. It is the exception in this district to pick up a really good seed when walking round an estate. Naturally,

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* This refers to Ceylon.

isolation in jungle would partially remedy this in that spores would be filtered by the jungle, and with about one or two sprayings the area could be kept healthy.

I think the best suggestion for getting a good strain of seed is to take a small area of rubber of known yielding quality. This should be carefully watched for 2-3 years, and in this time all bad milkers could be eliminated. This would probably leave you with about 40-50 trees per acre, and these the very best yielders. This area could be kept sprayed regardless of expense in order to keep down pod disease, and the seeds from it carefully collected. It would be better of course if it were isolated from the rest of the estate to prevent any cross-fertilisation, or it could be surrounded by a belt of some quick-growing trees, such as Albizzias, to help in preventing cross-fertilisation.

The seed from such an area would not of course be a pure strain, but this could be allowed for by planting an excess of trees per acre up to 200. It is not the truly scientific method but is the most rapid one whereby a fairly pure strain could be obtained; proper scientific methods would take about 20 years' work to obtain a really satisfactory result.

Mr. Marsden raises one or two points of a more general nature. He is of opinion that the seeds selected should be not only from trees of established good yielding capacity, but also of good bark-renewing ability. Presumably the bark-renewing ability is chiefly a question of the general health of the tree, and consequently in selecting seeds from good milkers we should avoid weakly or diseased trees. Until seeds of good milkers only are available, Mr. Marsden considers that small extensions can be made without fear of disappointment if:—

(1) The healthiest plants in the nursery be taken for planting.

(2) The plants be well planted in properly cut holes.

(3) A sufficient number of trees per acre be planted, at least 150 trees per acre, to afford plenty of trees for selection in thinning out when the trees come into bearing.

We are indebted to the Rubber Growers' Association for permission to publish these extracts from their Reports.

III.—DECADES KEWENSES

PLANTARUM NOVARUM IN HERBARIO HORTI REGII CONSERVATARUM.

DECAS XC.

891. **Aconitum funiculare,** *Stapf* [Ranunculaceae-Helleboreae]; inter species sectionis *Napelli* tuberibus hornotinis pluribus funicularibus insigne.

Tubera (in specimine unico viso) 5; unum annotinum, caetera hornotina, omnia cylindrica, basin versus attenuata, tota longitudine radices secundarias circiter 1 cm. distantes emittentia, 3-9 cm. longa, 2-5 mm. diametro, viva pallide fusca, fractura nivea amylacea, sapore tolerabili; cambium cylindrum centrale

tenuissimum formans. *Gemmae* tuberum breviter conicae, 3-5 mm. altae. *Caulis* erectus, 4-5 dm. altus, gracilis, pilis reversis crispo-pubescens vel superne tomentellus. *Folia* infrafloralia sub anthesi 2, caetera 4 ramulos unifloros (vel si mavis pedicellos) suffulgentia, sensim reducta, illa ambitu reniformia, circiter 3 cm. alta, 6 cm. lata, sinu lato, 5-pedato-partita, carnosula, utrinque sparse minute pilosula, segmentis cuneatis interioribus 3-lobatis extimis 2-lobatis, lobis late linearibus vel lineari-lanceolatis acutis; petiolus infimus 5 cm. longus, folii floralis infimi brevissimus, omnes parce minute pubescentes. *Racemus* pauciflorus; pedicelli distantes, 10-6 cm. longi, pube eadem ac caulis induti, medio 2-bracteolati, bracteolis pedicellis superioribus integris lineari-lanceolatis ad 1·5 cm. longis. *Sepala* pubescentia, decidua, summum galeiforme, galea erecta apice depressa et in rostrum breve subacutum horizontaliter producta ad 2 cm. alta superne 1 cm. lata (a latere visa) lilacina, rostro virescente; sepala lateralia oblique rotundato-obovata, vix unguiculata, 1·3–1·4 cm. diametro, cum galea contigua, superne pallida, inferne magis saturate lilacina, supra medium viridimaculata; sepala infericra elliptica, subacuta, circiter 1 cm. longa, violescentia vel virescentia. *Nectariorum* ungues in galea recte ascendentes, apice prorsus curvati, 14–18 mm. longi, summo parce pilosuli; mitella horizontalis vel cernua, latissima, suborbicularis, dorso vix gibbosa, glandula terminali lata viridi vel violacea, labio lato integro obtusissimo recurvo albido. *Filamenta* glabra, a medio basin versus alata, pallida, supra intense coerulea. *Carpella* 5, subcontigua, patule pubescentia, apice abrupte contracta; styli 2 mm. longi.

Bhotan, without precise locality, *Cooper* 3586.

The affinity of this new Aconite lies probably with *A. Hookeri*, Stapf, with which it has much in common, as the general structure of the tubers, the facies of the leaves, the inflorescence and the shape of the nectaries, but it differs from it in the absence of the characteristic hypogaeous portion of the stem and in the remarkable rope-like tubers, which are unique in the section *Napellus*. The plant was raised at Kew from seed collected by Mr. R. E. Cooper for Bees, Limited.

892. **Polyalthia Parkinsonii,** *Hutchinson* [Anonaceae-Unoneae]; species foliis eis *P. sumatranae*, Miq., valde similibus sed floribus in ramulis annotinis dense fasciculatis, pedicellis gracilioribus, petalis brevioribus et fructibus haud costatis differt.

Arbor parva; ramuli annotini florum fasciculos densos gerentes, leviter flexuosi, 6–7 mm. crassi, cortice cinereo lenticellato rugoso obtecti, efoliati, hornotini fusco-brunnei, circiter 2·5 mm. crassi, glabri, internodiis circiter 2 cm. distantibus. *Folia* oblonga, obtuse subabrupte acuminata, basi obtusa et leviter inaequalia, 10–20 cm. longa, 3–6 cm. lata, chartacea, glabra, supra subnitida, tenuiter reticulata, infra albo-glauca; costa supra impressa, infra conspicua; nervi laterales utrinsecus 8–10, graciles, utrinque prominuli, marginem versus arcuati; petioli 0·7–1 cm. longi, nigri, minute transverse rugosi, glabri. *Flores*

in ramulis efoliatis annotinis dense fasciculati, numerosi; pedicelli subgraciles, 2 cm. longi, glabri. *Sepala* 3, triangularia, obtusa, 1·75 mm. longa, minute pubescentia, coriacea. *Petala* 6–7, oblonga vel anguste oblonga, obtusa, circiter 1·3 cm. longa, 2 mm. lata, coriacea, extra dense tomentella, intra parce tomentella. *Stamina* sessilia, brevissima, 0·75 mm. longa, connectivo truncato crasso. *Carpella* parva, glabra, stigmate sessili truncato crasso coronata. *Fructus* subglobosus, breviter stipitatus, circiter 2 cm. diametro, glaber, subnitidus.

India. Andaman Islands: Long Island; Bom-ling-la, Feb., fr., *Parkinson* 943; without precise locality, Dec., fls., *Parkinson* 765, 794.

893. **Leea Venkobarowii,** *Gamble* [Vitaceae]; species distincta, nullae aliae peraffinis, foliolis lanceolatis asperis serratis, floribus albo-viridibus et lobis tubi staminiferi integris vel minute apiculatis insignis.

Frutex humilis, subherbaceus, ramulis ultimis striatis puberulis. *Folia* bipinnata, ad 40 cm. longa; foliola lanceolata vel ovato-lanceolata, apice longe acuminata, basi rotundata vel interdum, praecipue lateralia, cordata, margine serrata serraturis, 1–2 ad quemque nervum lateralem; pagina superior strigosa, aspera, inferior ad nervos et reticulationem crispato-pubescens; nervi laterales oppositi, utrinque circiter 8–12, nervulis transversis subparallelis; petiolus communis 6–14 cm. longus. *Flores* albo-virides, in cymas corymbosas in foliorum supremorum axillis per paria dispositi; corymbi 6–12 cm. longi, aperti, ad 5 mm. lati. *Calyx* campanulatus, puberulus, lobis ovatis tubo aequilongis 1 mm. longis. *Petala* ovato-oblonga, reflexa, apice cucullata. *Tubus stamineus* lobis 5 oblongis apice integris vel minute apiculatis; antherae introrsum spectantes, ad margines connatae. *Ovarium* ovatum, glabrum, stylo brevi, stigmate capitato. *Fructus* non visus, sed niger dictus.

South India. Anamalai Hills, Coimbatore district, 940 m., *J. S. Gamble* 14646. Hills of Travancore, in evergreen forests, up to 1310 m., *Venkoba Row.*

Dried specimens, as pointed out some years ago on an examination of my specimen, by Sir George King, resemble those of *L. setuligera,* C. B. Clarke, but the flowers are greenish and not red, and the lobes of the staminal tube are quite different. Mr. Venkoba Row calls it a "tree rising to 30 ft.," but probably he was thinking of his gatherings of *Leea sambucina,* a totally different species. This is probably an undershrub like *L. crispa.*

894. **Ellipanthus neglectus,** *Gamble* [Connaraceae]; *E. monophyllo,* Benth. et Hook. f., affinis, floribus majoribus et foliorum nervatione distincta, nervis lateralibus conspicue arcuatim junctis differt.

Arbor parva, ramulis teretibus ultimis molliter ferrugineo-puberulis. *Folia* unifoliolata, coriacea, elliptica, apice subito cuspidato-acuminata, basi cuneata, 8–12 cm. longa, 3–5·5 cm.

lata, supra praeter costam glabra, nitida, reticulata, infra ad costam et nervos pubescentia; nervi laterales utrinque 7–8, curvati, conspicue arcuatim juncti et marginem versus arcubus multis minoribus muniti, reticulatione conspicua; petiolus 1–1·5 cm. longus, pubescens. *Flores* in racemos axillares ferrugineo-tomentosos fasciculatos 1–1·5 cm. longos dispositi. *Calycis lobi* ovati, acuti, 1·5 mm. longi. *Petala* oblonga, extus villosa, intus glabra, 5 mm. longa. *Stamina* alternatim longa et brevia, omnia filamentis subulatis dense ferrugineo-sericeis. *Ovarium* strigoso-villosum. *Folliculi* ovati, dense ferrugineo-velutini, 2–2·5 cm. longi, stipite 6–7 mm. longo, sepalis et filamentis generaliter persistentibus. *Semen* oblongum, apice ex folliculo exsertum, basi arillo brevi roseo circumdatum; testa nigro-coerulea, nitida; cotyledones plano-convexi. *E. monophyllus* var. *neglectus*, O. Kze. MSS. in Herb. Kew. *E. Thwaitesii*, Brandis, Ind. Trees, 212; Bourdillon, Travancore Trees 128, non *Hook. f.*

South India. Hills of Tinnevelly, *Beddome;* Travancore, in evergreen forests at low levels, *Bourdillon; Venkoba Row.*

895. **Crotalaria Bidiei,** *Gamble* [Leguminosae-Genisteae]; *C. alatae*, Ham., affinis, foliis dimorphis, alis stipularibus longe auriculatis, floribus et legumine majoribus differt.

Suffrutex erectus, ferrugineo-pubescens. *Folia* dimorpha, brevissime petiolata, inferiora ovata, apice acuta, mucronata, basi attenuata, 4–7 cm. longa, 2–4 cm. lata, infra subglauca, superiora in ramulis ultimis anguste lineari-oblonga, griseo-fulvo-pubescentia, ad 4 cm. longa, 5 mm. lata; alae stipulares 1–2 mm. latae, superne auriculis longis acuminatis erectis vel paullo recurvis munitae. *Racemi* axillares, pauciflori, 5–9 cm. longi, longe pedunculati; flores 10–15 mm. longi; bracteae et bracteolae ovatae, acuminatae. *Calyx* paullo bilabiatus, 1·5 cm. longus, lobis longe acuminatis corolla longioribus. *Corolla* flava; vexillum orbiculatum, basi auriculis duabus munitum; alae oblongae, in unguem brevem abrupte angustatae; carinae petala rostrata dorso juncta basi ungue brevi instructa, marginibus ciliatis. *Ovarium* glabrum. *Legumen* cylindricum, glabrum, maxime inflatum, breviter (5 mm.) stipitatum, 4 cm. longum, 1–1·5 cm. latum, seminibus plurimis.

South India. Nilgiri hills, 1873, *Dr. G. Bidie; Beddome;* Neddikarna to Nedimballi, South Wynaad, Jan. 1903, *C. A. Barber* 5627.

896. **Crotalaria Clarkei,** *Gamble* [Leguminosae-Genisteae]; *C. triquetrae*, Dalz., affinis, robustior, ramulis quadrangulis raro triquetris, floribus majoribus et legumine patule villoso 3 cm. longo differt.

Suffrutex erectus, gracilis, ramis quadrangulis, ramulis aliquando triquetris strigoso-hirsutis. *Folia* brevissime petiolata, chartacea, ovato-oblonga, apice obtusa vel acutiuscula, basi obtusa vel subcordata, 2–4·5 cm. longa, 0·75 to 1·5 cm. lata,

marginibus reflexis, utrinque pilis basi bulbosis strigoso-hirsuta; nervi utrinque circa 8, paria 2 infima basi orta; stipulae lanceolatae, 3–4 mm. longae, reflexae. *Racemi* terminales, 12–18 cm. longi, 3–8-flori, floribus distantibus sed prope apicem numerosioribus; bracteae parvae, ovatae, acutae; bracteolae lineares, minimae. *Calyx* ad 1 cm. longus, lobis patentibus lanceolatis ferrugineo-villosis. *Corolla* calyce longior, flava; vexillum obovatum, dorso sericeo-villosum, ad 15 mm. longum; alae oblongae, paullo breviores, basi unguiculatae; carinae petala rostrata, dorso parce villosa, marginibus ciliatis. Ovarium oblongum, dense sericeo-villosum. *Legumen* oblongo-cylindricum, pilis sericeis patentibus dense vestitum, 3 cm. longum, seminibus circa 15-25.

South India. Nilgiri Hills at Naduvatam, 1800 m., *C. B. Clarke* 1136; *M. A. Lawson;* Devala, 920 m., *Gamble* 15622; Anaimalai Hills, *Beddome;* Pulney Hills, Silver Cascade Ridge, etc., *Bourne* 1072; *Beddome; Saulière;* South Tinnevelly, *Beddome;* Courtallum, *Wight.*

897. **Crotalaria scabra,** *Gamble* [Leguminosae-Genisteae]; *C. barbatae,* Grah., affinis, floribus minoribus et foliis ellipticis duris circiter 3 cm. solum longis 1·5 cm. latis marginibus conspicue reflexis scabro-hirsutis nec sericeo-villosis differt.

Frutex (?) erectus, ramulis scabris pilis basi bulbosis strigosis, ultimis ferrugineo-pubescentibus. *Folia* dura, elliptica, apice obtusa vel raro subacuta, basi rotundata, 2–3·5 cm. longa, 1–1·5 cm. lata, marginibus reflexis, supra parce infra densius pilis hirsutis basi bulbosis munita; petiolus perbrevis aut nullus; stipulae 0. *Flores* in racemos terminales 6–10 cm. longos dense ferrugineo-villosos dispositi; bracteae lineares, 5–7 mm. longae; bracteolae e tubo calycino ortae, lanceolatae, 5 mm. longae. *Calyx* bilabiatus, dentibus 2 superioribus lanceolatis 12 mm. longis, 3 inferioribus linearibus paullo longioribus intra glabris extra pilis rigidis dense sericeo-villosis. *Corolla* flava (?); vexillum orbiculatum, 1·5 cm. diametro, basi glandulis 2 pubescentibus munitum; alae oblongae, vexillo aequales, basi unguiculatae; carinae petala rostrata, unguiculata, marginibus pubescentibus. *Ovarium* glabrum, apice curvatum. *Legumen* cylindricum, glabrum, inflatum, breviter stipitatum, 3 cm. longum, 1–1·5 cm. latum.

South India. Tinnevelly District, on Agastyamalai Peak, 1920 m., May, 1901, *C. A. Barber* 2931.

898. **Crotalaria shevaroyensis,** *Gamble* [Leguminosae-Genisteae]; species *C. longipedi,* Wight & Arn., et *C. subperfoliatae,* Wight, affinis, ab hac pedicellis alternis et leguminibus fere glabris, ab illa bracteolis a calyce distantibus et bracteis reflexis persistentibus supra nitidis viscosis differt.

Suffrutex erectus, ferrugineo-villosus, paniculatim ramosus. *Folia* obovato-oblonga, subsessilia, apice cuspidato-acuta, basi attenuata, 4–8 cm. longa, 2–3 cm. lata, utrinque sericeo-villosa, nervis utrinque circa 7 infra conspicuis; stipulae parvae, lineares,

vel 0. *Paniculae* pyramidatae, ramis multiracemosis, bracteis multis persistentibus alternis vel oppositis reflexis nigris ornatis. *Racemi* circiter 3–5-flori, 6–8 cm. longi; bracteae ovato-acuminatae, 1 cm. longae, supra glabrae, nitidae; bracteolae a calyce circa 7 cm. distantes, ovato-acuminatae, 6–7 mm. longae. *Calyx* circiter 1·7 cm. longus, lobis margine revolutis, 2 superioribus lanceolatis, 3 inferioribus linearibus. *Corolla* flava, exserta; vexillum suborbiculare, apice acutum, dorso sericeo-villosum, fere 2 cm. diametro; alae oblongae, vexillo paullo breviores, basi conspicue unguiculatae; carinae petala rostrata, glabra sed margine ciliata. *Legumen* oblongum, glabrum vel minutissime puberulum, apice attenuatum, basi in pedicellum conspicuum 1 cm. longum attenuatum, 3·5–4 cm. longum, seminibus circa 16.

South India. Yercaud, Shevaroy Hills, Salem district, about 1600 m., *Dr. G. Bidie; Bourne* 2197; Madura district, *Beddome*.

899. **Crotalaria sandoorensis,** *Beddome* MSS. in Herb. Kew. [Leguminosae-Genisteae]; *C. lunulatae*, Heyne, et *C. paniculatae*, Willd., affinis, ab hac bracteis et bracteolis non linearibus; ab illa bracteis et bracteolis non lunulatis, ab ambabus stipulis minutis subulatis vel 0 nec conspicuis, etiam legumine exserto, seminibus 5–7 differt.

Suffrutex erectus, molliter ferrugineo-villosus, paniculatim ramosus. *Folia* subsessilia, lanceolata, mucronata, 4–5 cm. longa, 1–1·25 cm. lata, utrinque pilis longis mollibus sericeis villosa, nervis utrinque circa 6–7 inconspicuis; stipulae minutae, subulatae vel 0. *Paniculae* pyramidatae, ramosae. ramis 1–3-floris, bracteis multis ovato-acuminatis reflexis supra nitidis viscosis siccitate nigris; bracteae sub pedicello 7 mm. longae, subcordatae, longe acuminatae, supra glabrae; bracteolae binae similes e medio pedicello ortae, a calyce 4 mm. distantes. *Calyx* 1·25 cm. longus, lobis longe acuminatis margine reflexis; lobi 2 superiores lanceolatae, 3 inferiores angustiores. *Corolla* calyce duplo longior; vexillum obovatum, dorso sericeum, 1·5 cm. diametro; alae angustae, oblongae, 1·75 cm. longae; carinae petala rostrata, glabra, margine ciliato excepta. *Legumen* oblongum, obtusum, pilis longis villosum, 2 cm. longum, seminibus magnis 5–7.

South India. Sandoor Hills, Bellary district, May, 1880, *Col. R. H. Beddome*.

900. **Chrysopogon setifolius,** *Stapf* [Gramineae-Andropogoneae]; affinis *C. pallido*, Stapf (*Andropogoni pallido*, Kunth), sed foliorum laminis subsetaceis canaliculatis, panicula contracta angustissima, spiculis muticis, callo brevi breviter barbato distinctus.

Gramen sine dubio perenne, circiter 4 dm. altum. *Culmi* pergraciles, erecti, simplices, 3-nodi, internodio summo solo exserto. *Foliorum* vaginae basales exteriores haud visae, caeterae teretes, nervoso-striatae, infima in dorso, imprimis

margines versus, et ad os pilosa, superiores glabrae, laeves, summa lamina destituta; ligulae ad marginem ciliolatum redactae; laminae subsetaceae, lateraliter leviter compressae, canaliculatae, ad 20 cm. longae, ad 0·75 mm. latae, ligulam versus pilosae, praeter apicem scaberulum laeves, nervoso-striatae. *Panicula* angustissima, contracta, ad 9 cm. longa; rhachis gracilis uti rami glabri laevesque, hice ad nodos solitarii vel interdum 3–4-tim verticillati, tenuiter filiformes, 5–20 cm. longi, erecti, apice paulo incrassato albido-ciliato; pedicelli filiformes, glabri, ad 4·5 mm. longi. *Spicula sessilis* lineari-lanceolata, acuminata, pallida, glabra, 8 mm. longa; callus perbrevis, obtusus, barbatus, pilis antice ad 2 mm. longis. *Glumae* aequales; inferior margines versus a medio sursum aculeolata, dorso praeter apicem asperum laevissima, nervis tenuissimis intracarinálibus 5, extracarinalibus utrinque 2; superior in carina superne aspera, nervis 6–7, margine ciliata *Valva* anthoecii inferioris 6–7 mm. longa, tota hyalina, 2-nervis, reverse ciliata, superioris explanata elliptico-lanceolata, acuta, 4·5 mm. longa, mutica, in dorso anguste chartacea, caeterum hyalina, ultra medium tenuissime 3-nervis, abhinc 1-nervis. *Valvula* phyllis 2 a basi liberis lineari-oblongis ciliatis, 2·5 mm. longis 1-nervibus substituta. *Lodiculae* carnosae, late cuneatae. *Stamina?* *Stigmata* plumosa, paulo supro basin lateraliter exserta. *Spiculae pedicellatae* ♂, pallidae, anguste lanceolatae, acutae, 8 mm. longae. *Glumae* aequales, glabrae, inferior circiter 9-nervis, superior 3–5-nervis. *Valva* inferior 6 mm., superior 5 mm. longa, hacce tota hyalina, 3-nervis. *Antherae* 2·5 mm. longae.

North Australia. Port Darwin, *Schultz* 661.

The replacement of the valvule by two 1-nerved phylla is very unusual and suggests some anomaly in the development of the spikelets. These appear, however, perfectly healthy in every respect, and are of the usual gryllus-type, except for the absence of an awn in the upper floret whose value is, moreover, chartaceous over a narrow portion of the back. But even if these peculiarities of the sessile spikelets should prove to be anomalous, the structure of the leaf-blade alone would suffice to distinguish this species from all the other species which are immediately allied to *Chrysopogon Gryllus*, Trin.

IV.—THE BOTANIC STATION, KADUNA.

In the Annual Report of the Agricultural Department, Northern Provinces, Nigeria, for 1914 reference was made to the establishment of the new capital at Kaduna and the planting of the place with economic and ornamental trees. It was announced that a strip half a mile long had been chosen along the river bank near the new site, nurseries made and a large number of seedling trees grown. Choice Citrus and Mango trees had also been introduced from Dominica and Trinidad and been propagated successfully by grafting and budding.

In the Annual Report of the Department for 1915, recently received, the Director of Agriculture gives the following particulars about the new station:—

"The approximate latitude of this station is 10 degrees north, its height above sea level is roughly 2000 feet, and its average rainfall about 50 inches.

'The rainfall for 1915 amounted to 61·82 inches, and was confined to the period from March 17th to October 12th, inclusive.

"The site on the bank of the Kaduna River, which was selected early in 1914 for a nursery garden, has proved most suitable. The area, comprising some 7 acres, and extending in a narrow strip close to the water for nearly half a mile, has now been enclosed by a wire fence. A tool-house, potting-shed, and concrete ant-proof trough, for striking cuttings, have also been added.

"A large number of trees and shrubs—both economic and ornamental—have been raised and planted in the new capital.

"Avenues have been established along $3\frac{1}{2}$ miles of road, and the boundaries of most of the compounds on either side have been permanently defined by means of hedges. All but the narrowest roads have been planted with a double avenue, involving therefore 4 rows of trees. The trees have been planted 20 feet apart in the row, so the number of trees required per mile has been approximately 1000.

"The principal trees employed have been *Albizzia Lebbek*, *Albizzia moluccana*, *Poinciana regia*, *Mangifera indica*, *Khaya senegalensis*, *Eriodendron anfractuosum*, *Tamarindus indica*, *Eucalyptus* spp., *Gliricidia maculata* and *Adenanthera pavonina*.

"The species most generally used for hedges are *Caesalpinia pulcherrima*, *Thevetia neriifolia*, *Melia Azedarach*, and the common lime.

"An area of some 22 acres intended for public gardens was cleared and stumped by hand. The ground was then prepared by means of Planet-Junior cultivators drawn by cattle.

"It has since been laid down with Doob grass (*Cynodon Dactylon*) partly from seed and partly with runners obtained from a plot established at Maigana in 1913.

"The result is very gratifying, a fair turf having been obtained in less than a year."

V.—MISCELLANEOUS NOTES.

Daniel Oliver.—The death, on 21st December, 1916, of Professor Daniel Oliver, F.R.S., LL.D., who for over a generation took a prominent part in the activities of the Royal Botanic Gardens, the reputation of which his eminent labours have done so much to enhance, has been felt as a personal loss by former and present members of the Kew staff. The deceased, who was in his eighty-seventh year, was the son of Daniel Oliver, Newcastle-on-Tyne, where he was born on 6th February, 1830. His early education was received partly in private schools, partly at the

Friends' School, Brookfield, near Wigton. His devotion to botanical study began at an early age, his first contribution to the subject being published when he was 17. Already an active member of the Tyneside Naturalists' Field Club, he became in 1851 a member of the Edinburgh Botanical Society, and in 1853 a fellow of the Linnean Society. His reputation in 1858 was already so thoroughly established as to lead to an invitation from Sir W. J. Hooker, then Director of Kew, to become an assistant in the Herbarium. A year later Oliver inaugurated a course of lectures on botany for the benefit of the young gardeners employed at Kew, which he conducted without a break until 1874. In 1861 Oliver was appointed professor of botany at University College, a position which he occupied till 1888. In 1863 he was elected a fellow of the Royal Society, and in 1864, on the retirement through ill-health of the late Mr. A. Black, he was appointed keeper of the Herbarium and Library at Kew, a post which he held until 31st May, 1890. His active participation in the work of the establishment continued, however, for five more years, as editor on behalf of the Bentham Trustees of Hooker's *Icones Plantarum*. He took, in addition, an active interest in the work of the Linnean Society, on whose council he served from 1861 to 1863, and again from 1872 to 1874. He also served on the council of the Royal Society in 1875-76, and again from 1880 to 1882. In the latter year the Edinburgh Botanical Society, of which he had long been a member, elected him one of their six British honorary fellows, and in 1884, on the motion of the council of the Royal Society, he was the recipient of a Royal Medal.

When Oliver retired from the public service in 1890 the First Commissioner of Works placed on record the high appreciation of Her Majesty's Government of the valuable services rendered by him to the Royal Botanic Gardens and the distinguished ability which he had brought to bear on the work of his department. In the following year the University of Aberdeen conferred upon him the honorary degree of LL.D., and in 1893 the Linnean Society awarded him its gold medal; the President, in handing him this award, summarised in the happiest terms his varied activities and his eminent services to botanical science (*K.B.* 1893, p. 188). Later in 1893 a portrait of Oliver by Mr. J. Wilson Forster was presented by a number of his friends to the Herbarium at Kew (*K.B.* 1894, p. 78).

A list of his contributions to botanical literature is given below.

List of Publications by the late Professor D. Oliver.

List of a few Plants found in Bouldersdale and Teesdale, together with the formations on which they were found. (Phytologist, ii. 1847, p. 986.)

Botanical notes of a week in Ireland during the present month, August, 1852. (Phytologist, iv. 1852, pp. 676-679.)

On certain structures observed in *Pentas carnea*, Benth. (Gard. Chron., 1852, p. 822.)

Note on *Pyrola rotundifolia*, var. *arenaria*. (Phytologist, iv. 1853, pp. 1119-1120.)

Abstract, &c., of a paper entitled "Observations on the growth in diameter of Dicotyledonous (Exogenous) Stems." (Trans. Tyneside Nat. Field Club, iii. 1854-58, pp. 64-68, t. 2.)

Memoranda of Plants collected by the *Coquet* in 1855. (Trans. Tyneside Nat. Field Club, iii. 1854-58, pp. 68-72.)

Note respecting certain glandular appendages of the Leaves in the autumn rosettes of *Epilobium montanum*. (Journ. Linn. Soc., i. 1857, pp. 190-191.)

Notes on Plants new to the Flora of Northumberland, with observations on some critical species. (Trans. Tyneside Nat. Field Club, iv. 1858-60, pp. 44-50.)

Note upon the occurrence of a Rotiferon in *Vaucheria*. (Trans. Tyneside Nat. Field Club, iv. 1858-60, pp. 263-265.)

The Indian species of *Utricularia*. (Journ. Linn. Soc., iii. 1859, pp. 170-190, t. 1.)

Observations on the structure of the Stem in certain species of the natural orders *Caryophylleae* and *Plumbagineae*. (Trans. Linn. Soc., xxii. 1859, pp. 289-294, tt. 50-51.)

Descriptions of new species of *Utricularia* from South America, with notes upon the genera *Polypompholyx* and *Akentra*. (Journ. Linn. Soc., iv. 1860, pp. 169-176.)

Notes upon the British Herbarium of the Linnean Society. (Journ. Linn. Soc., iv. 1860, pp. 194-198.)

Botanical Bibliography. Phanerogamia. 1860. (Nat. Hist. Review, i. 1861, pp. 360-398).—1861. (l.c. ii. 1862, pp. 416-485). —1862. (l.c. iii. 1863, pp. 574-625).

The Natural History Review, edited by G. Busk . . . [and others, including D. Oliver.] [New Series.] Vols. i.-v. London, 1861-65. 8vo.

The natural order *Aurantiaceae*, with a synopsis of the Indian species. (Journ. Linn. Soc., v. 1861, Suppl. 2, pp. 1-44.)

Official Guide to the Kew Museums. A Handbook to the Museums of Economic Botany of the Royal Gardens, Kew. [London], 1861. 8vo. pp. 82.—[Another ed.] Ib., 1862.—Ed. 2. Ib., 1863.—Ed. 3. Ib., 1866, pp. 86.—Ed. 4. Ib., 1868.—Ed. 5. Ib., 1871, pp. 87.—Ed. 6. Ib., 1875, pp. 92. [Eds. 3-6 with additions and corrections by J. R. Jackson.]

On *Sycopsis*. (Trans. Linn. Soc., xxiii. 1862, pp. 83-89, t. 8.)

Note on the structure of the Anther. (Trans. Linn. Soc., xxiii. 1862, pp. 423-428, t. 44.)

Note on *Hamamelis* and *Loropetalum;* with a description of a new *Anisophyllea* from Malacca. (Trans. Linn. Soc., xxiii. 1862, pp. 457-461, t. 48.)

The Atlantis Hypothesis in its botanical aspect. (Nat. Hist. Review, ii. 1862, pp. 149-170.)

The structure of the Stem in Dicotyledons. (Nat. Hist. Review, ii. 1862, pp. 293-329; iii. 1863, pp. 251-258.)

On the distribution of Northern Plants. (Proc. Roy. Inst., iii. 1862, pp. 431-433; Geologist, v. 1863, pp. 262-263.)

On some new species of *Amomum* from West Africa, by D. Oliver and D. Hanbury. (Journ. Linn. Soc., vii. 1863, pp. 109-110.)

Notes on the *Loranthaceae*, with a synopsis of the genera. (Journ. Linn. Soc., vii. 1863, pp. 90-106.)

Guide to the Royal Botanic Gardens and Pleasure Grounds, Kew. Ed. 22. London, 1863. 8vo. pp. 56 and 3 plans.—Ed. 23. Ib., 1865, pp. 59 and 3 plans.—Ed. 24. Ib., 1867, pp. 63 and 3 plans.—Ed. 25. Ib., 1870, pp. 110, text-figs. 56 and 7 plans.—Ed. 26. Ib., 1872, pp. 112, text-figs. 56 and 7 plans.—Ed. 27. Ib., 1875.—Ed. 28. Ib., 1878, pp. 118, text-figs. 54 and 8 plans.—Ed. 29. Ib., 1881.—Ed. 30 ["29"]. Ib., 1885, pp. 184, text-figs. 54 and 8 plans.

Note on the structure and mode of dehiscence of the Legumes of *Pentaclethra macrophylla*, Benth. (Trans. Linn. Soc., xxiv. 1864, pp. 415-420, t. 37.)

Lessons in Elementary Botany. The part on Systematic Botany based upon material left in manuscript by the late Professor Henslow. London & Cambridge, 1864. 8vo. pp. viii. 317, text-figs. 183. [Ed. 2 was published in 1869, and Ed. 3 in 1878. Both editions were reprinted several times, the last impression appearing in 1910.]

On four new genera [*Piptostigma, Rhaptopetalum, Leptocladus, Octolepis*] of Plants of Western Tropical Africa; and on a new species of *Paropsia* (*P. guineensis*). (Journ. Linn. Soc., viii. 1865, pp. 158-162, t. 12.)

Loranthaceae Mexicanae et Centro-Americanae. Enumeratio specierum hujus familiae, quas in regno Mexicano Liebmann et in America Centrali Orsted legerunt. (Vidensk. Meddel., Kjöbenhavn, vi. 1865, pp. 170-177.)

On *Hillebrandia*, a new genus of *Begoniaceae*. (Trans. Linn. Soc., xxv. 1866, pp. 361-364, t. 46.)

On the *Lentibularieae* collected in Angola by Dr. Welwitsch, with an enumeration of the African species. (Journ. Linn. Soc., ix. 1867, pp. 144-156.)

Notes upon a few of the Plants collected, chiefly near Nagasaki, Japan, and in the islands of the Korean Archipelago, in the years 1862-63, by Mr. Richard Oldham. (Journ. Linn. Soc., ix. 1867, pp. 163-170.)

On five new genera of West Tropical Africa [*Dasylepis, Pyramidocarpus, Ancistrocarpus, Enantia, Cleistochlamys*], with a note upon the genera *Oncoba* and *Mayna*. (Journ. Linn. Soc., ix. 1867, pp. 170-176.)

Note to Dr. T. Anderson's paper on two species of *Guttiferae*. (Journ. Linn. Soc., ix. 1867, pp. 261-263.)

Memorandum on the genus *Thamnea*, Solander, and other *Bruniaceae* contained in the South African Herbarium of the late Dr. Burchell. (Journ. Linn. Soc., ix. 1867, pp. 331-333.)

Phanerogamia and Vascular Cryptogamia of Greenland, 68°-70° N.L. (Trans. Edinburgh Bot. Soc., ix. 1868, pp. 447-452.)

Phanerogamia and Vascular Cryptogamia [of Disco Bay, Greenland]. (In Florula Discoana, by R. Brown; Trans. Bot. Soc. Edinb., ix. 1868, pp. 447-452. Reprinted in Manual of the Natural History . . . of Greenland, 1875.)

Flora of Tropical Africa, by D. Oliver, assisted by other

Botanists. Vols. i.-iii. London, 1868-1877. 8vo. [D. Oliver elaborated the following orders:—Vol. i. (pp. 14+xli.+179): *Ranunculaceae* to *Dipterocarpeae*, *Lineae* to *Geraniaceae* (*Impatiens* by Sir J. D. Hooker), *Rutaceae* to *Celastraceae* and *Anacardiaceae*. Vol. ii. (pp. viii.+613): *Leguminosae* (suborders *Caesalpinieae* and *Mimoseae*), *Saxifragaceae*, *Droseracae* to *Rhizophoraceae*, *Onagrarieae*, *Cactaceae*, and *Ficoideae*. Vol. iii. (pp. viii.+ 544): *Compositae* (with W. P. Hiern), *Ericaceae*, *Plumbagineae*, and *Primulaceae*.]

First Book in Indian Botany. London, 1869. 8vo, pp. xi.+ 393, text-figs. 242. [The last impression, the 9th, was published in 1911.]

Description of three new genera [*Allanblackia*, *Alsodeiopsis*, *Campylostemon*] from West Tropical Africa, belonging to the Natural Orders *Guttiferae*, *Olacineae*, and *Celastraceae*. (Journ. Linn. Soc., x. 1869, pp. 42-44.)

Notes of ten lectures on "Botany" delivered . . . in the . . . South Kensington Museum during March and April, 1870. [London, 1870.] 8vo, pp. 24.

The Botany of the Speke and Grant Expedition; an Enumeration of the Plants collected during the journey of the late Capt. J. H. Speke and Capt. (now Lieut.-Col.) J. A. Grant, from Zanzibar to Egypt, the determinations and descriptions by D. Oliver and others . . . with an introductory preface by Colonel Grant. (Trans. Linn. Soc., xxix. 1872-75, pp. 1-190, tt. 1-136 and Map.)

On *Begoniella*, a new genus of *Begoniaceae* from New Granada. (Trans. Linn. Soc., xxviii. 1873, pp. 513-514, t. 41.)

Descriptions of three new genera of Plants in the Malayan Herbarium of the late Dr. A. C. Maingay: [*Pteleocarpa*, *Ctenolophon*, *Maingaya*]. (Trans. Linn. Soc., xxviii. 1873, pp. 515-518, tt. 42-44.)

Illustrations of the principal Natural Orders of the Vegetable Kingdom. The plates by W. H. Fitch. London, 1874, obl. 4to. pp. 154, col. tt. 109.

List of Plants collected by H. N. Moseley on Kerguelen's Land, Marion Island, and Yong Island. (Journ. Linn. Soc., xiv. 1875, pp. 389-390.)

Note on *Lyallia kerguelensis*, Hk. f. (Journ. Linn. Soc., xiv. pp. 389-390.)

Note on a Fruit from Comassi, collected by Lieut. de Hoghton and sent to Kew by Major Bulger. (Journ. Linn. Soc., xiv. 1875, pp. 457-458.)

[List of Flowering Plants from Ellesmere Land and Grinnell Land.] (Sir G. S. Nares, Narrative of a Voyage to the Polar Sea during 1875-6. Vol. ii. 1878, pp. 302-312.)

List of Plants collected in New Guinea by Dr. A. B. Meyer, sent to Kew, December, 1874. (Journ. Linn. Soc., xv. 1875, pp. 29-30.)

Enumeration of Plants collected by V. Lovett Cameron, Lieut. R.N., in the region about Lake Tanganyika. (Journ. Linn. Soc., xv. 1876, pp. 90-97.)

Note on a collection of North Celebes Plants made by Mr.

Riedel, of Gorontalo. (Journ. Linn. Soc., xv. 1876, pp. 97-100.)

Remarks [on Dr. Kirk's paper: Note on specimens of *Hibiscus* allied to *H. rosa-sinensis*, L., collected in E. Tropical Africa 1875.] (Journ. Linn. Soc., xv. 1876, pp. 479-480, figs. 1-2.)

Enumeration of Plants collected in the region about Lake Tanganyika. (V. L. Cameron, Across Africa. Vol. ii. 1877, App. I.)

Copy of Professor Oliver's determination of Plants collected near Akaba . . . 1874. (E. Beke, The late Dr. Charles Beke's discoveries of Sinai in Arabia and of Midian, 1878, pp. 593-594.)

[Flowering Plants of the Arctic Regions.] (Sir A. H. Markham, A Polar Reconnaissance, 1881, App. A.)

[Botany of Matabele Land.] (F. Oates, Matabele Land, 1882, pp. 366-369, tt. J K.)

List of Plants collected by Mr. Thomson, F.R.G.S., on the Mountains of Eastern Equatorial Africa, by D. Oliver; with observations on their distribution by Sir J. D. Hooker. (Journ. Linn. Soc., xxi. 1885, pp. 392-406.)

Enumeration of the Plants collected . . . on the Kilima-njaro Expedition, 1884, by D. Oliver and J. G. Baker. (H. H. Johnston, The Kilima-njaro Expedition, 1886, pp. 337-349.)

List of Plants collected in the Islands of Bougainville Straits, Solomon Group, during 1884, by H. B. Guppy, [the determinations chiefly by D. Oliver.] (H. B. Guppy, The Solomon Islands and their Natives, 1887, pp. 294-304.)

The Botany of the Roraima Expedition of 1884; being notes on the Plants observed by Everard F. im Thurn, with a list of the species collected, and determinations of those that are new, by D. Oliver and others. (Trans. Linn. Soc., ser. 2, ii. 1887, pp. 249-300, tt. 37-46.)

Flora of Somali-Land. Plants collected . . . by Messrs. James and Thrupp. (F. L. James, The Unknown Horn of Africa, 1888, pp. 318-323, tt. 1-4.)

Hooker's Icones Plantarum. Third Series, vol. x. pt. 2 to Fourth Series, vol. v. pt. 1 (tt. 1926-2425), edited by D. Oliver. London, 1890-95. 8vo. [Besides editing the work he was the author of most of the text during this period. He also contributed frequently to previous volumes, dating back to the beginning of the Third Series in 1867, and supplied the text to 34 of the plates (2426-2486) issued after he ceased to be editor.]

Charles Crossland.—The news of the death of Mr. Charles Crossland, of Halifax, on December 9 will be received by British mycologists with great regret. Of a gentle and retiring disposition, Mr. Crossland was unknown personally to many, but in the north of England, and especially in his native county, his enthusiasm for all branches of field botany and especially mycology, coupled with his charm of manner, made him a leader beloved and respected.

Mr. Crossland was born at Halifax in 1844. He left school early, and, after being duly apprenticed, he became a butcher, in which trade he continued till comparatively recently. He was

early interested in botany and natural history, but it was not until 1888 that, at the suggestion of Mr. G. Massee, he took up fungi as a special study. Mr. Crossland's enthusiasm in collecting, his care in preserving and drawing his finds, gave him as years went on a thorough knowledge of the plants. He became an authority on the group of Discomycetes, and published many notes on these and other critical British fungi. For many years he was Secretary of the Mycological Committee of the Yorkshire Naturalists' Union, an enthusiastic band which has rendered Yorkshire mycologically famous. In 1902, in conjunction with Mr. Massee, he published a "Fungus Flora of Yorkshire," and two years later the "Flora of Halifax," in collaboration with W. B. Crump. Mr. Crossland was one of the founders of the British Mycological Society, a Fellow of the Linnean Society, and in 1907 he was President of the Yorkshire Naturalists' Union. His collections of dried fungi together with his beautiful series of coloured drawings were purchased by Kew in 1914 (see *Kew Bulletin*, 1914, p. 173). A sketch of Mr. Crossland's life and a list of his published works appeared in *The Naturalist*, 1910, pp. 367-374.

A. D. C.

Additions to Gardens.—Owing to difficulties caused by the war there was a great falling off in the exchange of plants, seeds, etc., between Kew and other establishments. The principal receipts were:—

Botanic Gardens and other institutions:

Arnold Arboretum—Hardy trees and shrubs.
Washington, Department of Agriculture—Various plants and seeds.
Loanda, Angola—Seeds of Palms, etc.
Egypt, Ministry of Agriculture—Seeds of *Hyoscyamus muticus* and of tropical trees and shrubs.
Kirstenbosch, Cape Colony—Seeds of Cycads and Narras (*Acanthosicyos horrida*).
Uganda, Forestry Department — Seeds of *Choananthus Cyrtanthiflorus* from Ruwenzori, Orchids, etc.
Singapore—Seeds of Palms, *Platycerium biforme*, etc.
Trinidad—Seeds of Palms.
Nairobi Forestry Department—*Encephalartos Hildebrandtii*, *Ansellia nilotica*, *Zamioculcas Loddigesii*, etc.

Donations from other sources include the following:

Mr. F. R. S. Balfour, Dawyck, N.B.—Various hardy trees and shrubs.
Mr. H. J. Elwes, Colesborne—Orchids, Nerines, and herbaceous plants.
Mr. M. T. Dawe, Director of Agriculture, Colombia—Collections of seeds.
Sir John Barran, Bart., Ripon—*Campanula Ephesia*.
Dr. G. V. Perez, Teneriffe—Seeds of Echiums, Genistas, etc.
Mr. J. C. Williams, Caerhays—Seeds of Chinese Rhododendrons, *Rosa sino-Wilsoni*, etc.
Booth Shipping Company, Liverpool—Palms from South America.

Sir George Holford, Westonbirt—30 hybrid Cymbidiums.
Mr. J. P. Leslie, Chatham—*Mesembryanthemum Lesliei.*
Mr. T. W. Harker, Muizenberg, South Africa—Seeds of *Protea.*
Mr. E. J. Harnett, Sydney—Seeds of Waratah (*Telopea speciosissima*).
Mr. C. J. Lucas, Horsham—Various Orchids and tropical shrubs.
Messrs. T. Rochford and Sons, Broxbourne—Large plant of *Psidium cattleianum* var.
Lady Max Waechter, Richmond—Collection of Orchids.
Lieut.-Col. Mainwaring, Trefnant—*Lonicera Griffithii.*
Messrs. Wallace and Sons, Colchester—*Primula helodoxa.*
Prof. A. Henry, Dublin—Seeds, *Larix olgensis.*
Sir E. G. Loder, Bart., Leonardslee—*Rhododendron Loderi* var. King George, Conifers, and other trees.
Hon. N. C. Rothschild, Oundle—Collection of Irises.
Mr. I. B. Pole-Evans, Pretoria—*Aloe suprafoliata*, *A. aculeata*, and various seeds.
Mr. G. Elisha, Canonbury Park—Mesembryanthemums.
Miss A. Sich, Chiswick—Bulbs from Uganda.
Mr. F. Monteith-Ogilvie, Oxford—Large plant of *Epidendrum prismatocarpum.*
Mr. H. G. Mackie, Buenos Aires—Seeds of *Quebrachia Lorentzii.*
Mr. B. C. Aston, Wellington, N.Z.—Seeds of New Zealand plants.
Messrs. Bees, Liverpool—Seeds from China and the Himalaya.
Mr. R. A. Nichol, Wellington, N.Z.—*Ranunculus Lyallii.*
Mr. A. E. Bowles, Waltham Cross—Herbaceous plants.
Duke of Northumberland—*Alnus Schmidtii.*
Mr. W. Fox, Kingston—Orchids and Aroids from the Seychelles.
Mrs. Woodward, Arley Castle—*Paeonia Woodwardii.*
Mr. W. O. Milner, Totley Hall—Seedlings of *Primula Winteri.*
Mr. T. F. Cheeseman, Auckland, N.Z.—Seeds of *Rhopalostylis Cheesemanii.*
Mr. H. Takeda, Japan—Seeds of *Glaucidium palmatum.*
Mrs. Waterhouse, Halifax—Large plant of *Todea superba.*
Mr. W. Cooke, Honda, Colombia—Seeds of *Posoqueria Cookei.*
Mr. J. Clissoldy, Paryahyba, Brazil—Seeds of *Pilocarpus Jaborandi.*
Mr. S. Stuart, Alaska—Seeds of Alaskan plants.
Mr. T. H. Lowinsky, Tittenhurst—Large Rhododendrons.
Hon. Vicary Gibbs, Aldenham—Various trees and shrubs.
Countess of Selborne—Seeds of *Meconopsis* sp.
Mr. Scoresby Routledge, Bursledon—Seeds of *Sophora Toromiro*, etc., from Easter Island.

Among the purchases made were orchids and other plants at the Red Cross Sale arranged by the Royal Horticultural Society;

specimen Filmy Ferns from the collection of the late Mrs. Waterhouse, Halifax, and a set of Odontiodas from Messrs. Charlesworth and Co., Hayward's Heath.

Surplus plants were distributed to various botanical gardens and public parks, and there was the usual distribution of seeds that had been saved during the year from the cultivated plants in the gardens. The total number of packages thus distributed was 2116 hardy herbaceous, and 1420 hardy trees and shrubs.

The most important of the seeds specially distributed were those of *Quebrahia Lorentzii* from the Argentine, a large forest tree, the wood of which is imported into this country and the United States for tanning purposes; *Aesculus indica*, the Indian horse chestnut; *Acanthosicyos horrida*, the African Narras; *Telopea speciosissima*, the Waratah; and *Sophora Toromiro*.

Surplus trees and shrubs were sent to Kneller Hall and other military stations, as well as to various Red Cross hospitals; also such bedding and herbaceous plants as could be spared after the planting at Kew.

Collections of plants were contributed from Kew to the Red Cross Sale held in the Horticultural Hall in June.

Arboretum.—The reduction of the staff has made it impossible to attempt much more than keep the grounds in order during 1916. At times even this proved more than could be done satisfactorily. The hay crop was unusually heavy, and this, combined with showery weather and inexperienced help, made its ingathering long and tedious. The consequence was that, by the time it was finished, weeds had got the upper hand, and the standard of cleanliness and order fell much below that of normal times.

More ground in the area of the collection of *Ericaceae* has been taken to provide for new Chinese rhododendrons, of which so many have been introduced during the last fifteen years. For the purpose, a mound close to the Holly walk and the *Arbutus* collection (H 7 on Key Plan) was cleared of a miscellaneous assortment of shrubs. A large oval bed was made, separated from which by a grass path are two long borders at the sides.

The storm of March 28th, 1916, is likely to be an historical one from the amount of damage wrought in London and the home counties. At Kew it will long be remembered on account of the destruction of the Sun Temple and the large cedar of Lebanon close by (see *Kew Bulletin*, 1916, p. 81). Since then, Kew has lost a tree of some note in the large red oak (*Quercus rubra*) which grew near the Pagoda. According to Elwes (*The Trees of Great Britain and Ireland*, V., p. 1245), this appears to have been in girth of trunk the third largest in the kingdom. Its upper growth was very much decayed and the occasional fall of large limbs made its removal necessary for safety. Its trunk measured 13 ft. 6 in. in circumference at 5 ft. from the ground and 17 ft. at the base, and the number of annual rings was about 170. It must, therefore, have been planted when Kew Gardens were the property of Frederick, Prince of Wales, the father of George III.

The Assistant Curator has visited and advised as to the treat-

ment of grounds and plantations attached to the following public institutions: Admiralty House, Portsmouth Dockyard; the Borstal Institute, Feltham; Kneller Hall, Twickenham. Trees and shrubs also have been supplied to the last named, to H.M. Training Depot at Osterley Park, the Red Cross Hospital, Richmond, and to Plymouth Corporation. Specimens of timber of various trees were supplied for experimental purposes to the Anti-Gas Department, R.A.M. College, London. Cuttings of *Populus Eugenei*—one of the most promising of quick-growing timber trees—have been distributed for trial to a number of private and public establishments. A number of species of *Rubus*, new and old, were sent to Mr. W. F. M. Copeland, of Southampton, who is making extensive trials in breeding and hybridising with a view to the production of new fruit-bearing kinds.

Additions to Tree and Shrub Collections.—An interesting gift to Kew made last autumn was a plant of *Cotoneaster integerrima*, Medic. (*C. vulgaris*, Lindl.). It was collected by the late Rev. Augustin Ley, a well-known British botanist, on Great Orme's Head in Carnarvonshire, and presented by his cousin, Miss Sibyl B. Gee, of Brampton Lodge, Herefordshire. This is the only species of Cotoneaster indigenous to the British Isles, and the only site on which it has been found is Great Orme's Head. It was originally discovered on the cliffs near Llandudno, then a small fishing hamlet, by Mr. J. W. Griffith in 1783.

During the year two consignments of trees and shrubs have been received from the Arnold Arboretum, including some new species of American *Aesculus* (a subject of recent study by Prof. Sargent), also new hickories, maples, birches, alders, and oaks. A number of plants collected by Dr. C. K. Schneider in China were included, most of them under numbers; a considerable proportion of these may prove new to science. Lt.-Col. F. R. S. Balfour sent from Dawyck about three dozen plants which had been noted as desirable for Kew. Col. Balfour has been endeavouring to introduce the interesting beech, *Nothofagus Dombeyi*, from Southern Chile. Seeds he sent to Kew were all, unfortunately, dead on arrival, but we learn that, out of a consignment of young trees, he hopes to save two alive. These may prove sufficient to establish this fine tree in cultivation.

From Mr. J. C. Williams, of Caerhays Castle, now the recognised headquarters of cultivated rhododendrons in Europe, several valuable contributions to this genus have been received. We have also to acknowledge gifts from Sir Edmund G. Loder, Miss Jekyll, Prof. A. Henry, and the Hon. Vicary Gibbs. To the deep regret of all who knew him, Canon Ellacombe died in February, and thus the garden of Bitton Vicarage, for the first time for very many years, makes no claim to our acknowledgments.

The United States Department of Agriculture sent, amongst other things, the very rare *Aesculus Wilsonii*, a new horse chestnut from Western China.

The following new trees and shrubs have flowered at Kew during the past year:—

Acanthopanax setchuenense.

Berberis atrocarpa.
,, Beaniana.
,, Edgworthiana.
,, Tischleri.
Ceanothus sanguineus.
Clematis Spooneri.
,, × verrierensis.
Disanthus cercidifolia.
Gaultheria pyroloides var. cuneata.
Hydrangea xanthoneura.
,, ,, var. glabrescens.
,, ,, var. Wilsonii.
Indigofera amblyantha.
,, pendula.
Lonicera longa.
Magnolia conspicua var. purpurascens.
Prunus tenuiflora.
Pyracantha Gibbsii.
,, crenulata var. Rogersii.
Rhododendron auriculatum.
,, haematodes.
,, oreotrephes.
,, rotundifolium (orbiculatum).
,, Williamsianum.
Rosa elegantula.
,, fasciculata.
,, floribunda.
Viburnum brevipes.
Vitis pulchra.
Wistaria venusta.

Museums.—During the past year no very considerable additions have been made to the permanent collections and but few duplicates have been available for distribution. A large number of miscellaneous products were received for determination from scientific institutions and commercial firms, and much general information has been given in this direction. As in the previous year, medicinal plants, oil seeds, food grains, and timbers have formed the bulk of the enquiries. Several changes have been made in the already depleted staff, but nevertheless much has been done to improve the collections, and a large number of products have been relabelled and otherwise improved. Although it has not been found possible to open to the public all the Museums, the closed buildings have been made available to about 200 individuals for special study.

A small room attached to the North Gallery, formerly used by Miss Marianne North as a studio, has been redecorated for the reception of Sir Arthur Church's collection of Botanical Drawings (see *Kew Bulletin*, No. 6, 1916, p. 162).

Presentations to Museums.—The following miscellaneous

specimens have been received in addition to those previously recorded in the *Bulletin*:—

Director, Botanic Gardens, Singapore.—Samples of wood of *Agathis robusta*, *Araucaria excelsa*, *Albizzia odoratissima* and *Cedrela Toona*.

Mr. M. T. Dawe, Director of Agriculture, Colombia.—Various specimens of fibre of Fique (*Furcraea gigantea*), see *Kew Bulletin*, No. 7, 1916, p. 169; series of carvings in the wood of *Spondias lutea*, and sample of bark-cloth of *Brosimum* sp. worn by the Indians of Manaos.

Messrs. Wigglesworth and Co., London, E.C.—Flax fibre from British East Africa.

Mme J. Pechat, Paris.—Ornamental door-knobs made of the crushed and compressed seeds of the Palmyra Palm (*Borassus flabellifer*).

Miss M. G. Downward, Richmond, Surrey.—A collection of West Indian Woods.

Mr. G. Farmer, Mombasa.—Photograph of Cocoanut Palm showing abnormal growth and of the Cocoanut Beetle (*Oryctes rhinoceros*).

Colonel Stephenson Clarke, C.B., Cuckfield, Sussex.—Transverse section of stem of *Pyrus torminalis*.

Messrs. Thomas and Green, Ltd., Wooburn, Bucks.—Sample of paper manufactured from reeds of *Phragmites communis*.

H.B.M. Consul-General, Buenos Aires.—Seeds of Quebracho (*Quebrachia Lorentzii*).

Mr. C. E. J. Esdaile, Taunton.—Plank of *Pinus insignis*.

Sir Daniel Morris, K.C.M.G., Boscombe, Hants.—Cones of *Pinus Pinaster* partially consumed by squirrels.

Mr. E. H. Man, C.I.E., Preston Park, Brighton.—1. Tôgo-chônga," or ornamental wristlets worn by young men at dances, etc. Made in part of immature leaf of *Pandanus* sp., the skin of *Dendrobium secundum*, fibre of *Anadendrum paniculatum*, and portions of *Dentalium octogonum*. South Andamans. 2. "Ok-ho," or bark-cloth made from the bark of a species of *Ficus* used for clothing, wrappers, etc. Great Nicobar. 3. Skin of an orchid (*Dendrobium secundum*, South and Little Andaman.

Professor F. W. Oliver, F.R.S., University College, London.—Paper manufactured from *Spartina Townsendii* collected in Poole Harbour.

Mr. L. Fosbrooke, Ashby-de la-Zouch.—Plank of Fulham Oak (*Quercus fulhamensis*).

Mr. C. H. Scriven, Thong, Gravesend.—Photographs of a large Yew Tree at Melliker, Meopham, Kent.

Mr. Alfred Dobree, Buckingham Gate.—Photographs of various articles in silver designed from fruits, leaves, etc.

J. M. H.

Research in Jodrell Laboratory in 1916.—Mr. J. Bintner examined cuttings of several species of plants in relation to the development of callus-tissue.

Mr. L. A. Boodle made experiments on the maceration of

plant-fibres, and studied the anatomical structure of a number of plants.

Miss T. L. Prankerd was engaged in a research on geotropic irritability in Ferns.

Miss F. M. Scott investigated the anatomy of the stem of a species of *Aegialitis*, and carried out some other anatomical work.

Mr. H. Takeda made observations on some Freshwater Algae, and completed his study of a species of *Chlamydomonas*.

Mr. W. C. Worsdell studied a number of teratological specimens in relation to their morphological nature, and examined the anatomy of *Polygonaceae*, etc.

Pathology.—In spite of war conditions the amount of material sent during the past year to the Pathological Laboratory for examination and report showed no falling off over 1915. The fungus *Ophiobolus graminis* produced, in various parts of the country, blindness in wheat, and such blind ears especially were attacked by *Cladosporium herbarum*, and these were submitted in quantity during the wet weather in September. Some bad cases of Black-leg in potatoes were investigated during the summer, and this malady together with "Leaf Roll" was very prevalent in the plot of "King Edward VII." in the experimental ground. *Rhizoctonia violacea* was found to be causing serious trouble in mangels in the south-west of England, and it appeared to be also more than usually frequent in other plants. The wet season was responsible for a very severe outbreak of Phytophthora on potatoes which had already suffered through a check received earlier in the season and caused by the drought in May. Revision and re-writing of the Board of Agriculture Leaflets also occupied a considerable amount of time.

Such routine work prevented much of the research which had been planned from being accomplished, but in spite of this, investigations on American Gooseberry Mildew, Wart Disease of potatoes, diseases of apples, figs, and other plants have been carried out, and some results already published.

Presentations to the Library during 1916.—In the Kew set of the six volumes constituting Sir J. D. Hooker's classical work, *The Botany of the Antarctic Voyage*, the plates of only two volumes—those devoted to the *Flora Tasmaniae*, and a few of the *Flora Antarctica*—are coloured. The library now possesses a copy of the latter Flora in which all the plates are coloured, and for this valuable presentation it is indebted to the Bentham Trustees. All the volumes of the work are now very scarce, but it is hoped that eventually it will be possible to replace the uncoloured copy of the *Flora Novae-Zelandiae* in the library by a coloured one. Volumes, or parts in continuation of numerous periodicals, received in exchange for *Hooker's Icones Plantarum*, have also been presented by the Bentham Trustees.

From the Secretary of State for India the following have been received:—The first part of a *Flora of the Presidency of Madras*,

by J. S. Gamble (a copy of which has also been presented by the author), *A Manual of Elementary Botany for India*, by R. B. K. Ranga Aclari, and further issues of the *Madras Presidency College Botanical Bulletin*, containing Prof. Fyson's figures and descriptions of Madras Plants.

The Under-Secretary of State for Egypt has presented eleven bulletins of the Technical and Scientific Service of the Ministry of Agriculture, Egypt, and a *Report on the great invasion of Locusts in Egypt in* 1915.

The Trustees of the British Museum have presented the *Report on Collections of Natural History made in the Antarctic Regions during the Voyage of the "Southern Cross,"* and the two volumes of the *Catalogue of the Mesozoic Plants in the British Museum: The Cretaceous Flora*, by Dr. Marie Stopes.

From Lady Church have been received a complete set of the *Dictionary of the Economic Products of India*, by Sir G. Watt, *Indian Art at Delhi*, 1903, by the same author, and a volume of *Technical reports and scientific papers*, edited by W. R. Dunstan; from Lady Hooker, the continuation of the *Comptes Rendus des Séances del' Académie des Sciences*, Paris; and from Miss Alice Eastwood, the weekly issues of *Science* for the year.

From Sir Frank Crisp, Bart., have been received a copy of P. C. van Géel's *Sertum Botanicum*, published in Brussels in 1828 to 1832, and a complete set of the *Dictionnaire icono-graphique des Orchidées*, by A. Cogniaux and A. Goossens.

Sir W. T. Thiselton-Dyer has presented a number of pamphlets, a large collection of notes, cuttings, etc., relating to the history of the Royal Botanic Gardens, Kew, photographs of plants of special morphological interest, and a volume of manuscript notes, with drawings, on his botanical lectures delivered at South Kensington for the Science and Art Department in 1873.

A German translation, apparently very little known, of Burchell's *Travels in the Interior of South Africa*, has been presented by Dr. W. Botting Hemsley. This was published at Weimar in 1822 and 1825, and is in two octavo volumes, forming part of the *Neue Bibliothek der wichtigsten Reisebeschreibungen*, edited by F. J. Bertuch. Only one of the plates issued in the original work appears with the translation, and the Latin diagnoses of plants and animals are omitted. The copy now acquired formerly belonged to Burchell himself, and is in excellent condition. Dr. Hemsley has also presented *Unpublished Documents on the History of the Seychelles Islands anterior to* 1810, etc., by A. A. Fauvel.

Prof. Hans Schinz has supplied the library with further numbers of the *Mitteilungen aus dem botanischen Museum Zürich*, No. 70 of which consists of the second part of *Die Flora des Val Onsernone*, by J. Bär. Other contributions from Prof. Schinz are:—*Die Vegetationsverhältnisse des Pflanzenschon-bezirkes bei Berchtesgaden*, by K. Magnus, and *Weitere Beiträge zur Kenntnis der Wirkung von Bakterien auf Gemüsekonserven*, etc., by G. Rudolph.

Prof C. S. Sargent has sent four more parts of the *Plantae Wilsonianae*, which has now reached the second part of vol. iii.,

and E. H. Wilson's monograph, *The Cherries of Japan*; also a copy of a facsimile reprint of a *Catalogue d'Arbres, Arbustes et Plantes Herbacées d'Amérique*, by William Young, Jr., originally published in Paris in 1783; this reprint, which is furnished with an account of the author and critical notes, has been edited by S. N. Rhoads.

The Subantarctic Islands of New Zealand:—Reports . . . . edited by C. Chilton, and *Index Faunae Novae Zealandiae*, edited by Captain F. W. Hutton, have been received from the Philosophical Institute of Canterbury, New Zealand; and a bound volume of the *Reports of the Botanic Gardens and Domains*, &c., *Sydney*, 1896-1914, from their author, Mr. J. H. Maiden, who has also presented the continuation of his Critical Revision of *the Genus Eucalyptus*, and two copies of a *Census of New South Wales Plants*, compiled by himself and the late Mr. Ernst Betche.

A selection of the numerous publications of the United States Department of Agriculture have been received from the Secretary of Agriculture, Washington, those of the Department of Agriculture in the Dutch East Indies, the continuation of the *North American Flora*, published by the New York Botanical Garden, and the first part of the *Archivos do Jardim Botanico do Rio de Janeiro*, from the Directors of the respective establishments.

Other contributions to the library, received from their authors or publishers are:—*The Standard Cyclopedia of Horticulture*, by L. H. Bailey, vols. iv. and v.; *Marine Algae of the Danish West Indies*, by F. Börgesen, vol. ii. pt. 2; *Philippine Dipterocarp Forests*, by W. H. Brown and D. M. Mathews; *La Végétation de Paraguay*, by R. Chodat; *Lichenum Lusitanorum* . . . *Catalogus*, and other publications, by A. X. P. Coutinho; *A Hausa Botanical Vocabulary*, by J. M. Dalziel; *Third Annual Report of the Botanical Office* . . . *British Columbia*, by J. Davidson; *Jacob Georg Agardh: Minnesteckning*, by J. *Eriksson; A Glossary of Botanic Terms*, by B. Daydon Jackson, ed. 3; *Le Marchantiaceae della Flora Europea: Monografia*, and several pamphlets, by C. Massalongo; *Shokubutsu-mei-i* . . . Part 2: *Japanese Names of Plants*, by J. Matsumura; *The Flora of the Bagshot District*, by H. W. Monckton; *Flora Sylvatica Koreana*, pts. 1, 2, 4, and 5, and a *Report on the Vegetation of Mount Waigal-bon, North Korea*, by T. Nakai; a second copy of the *Materials for a Flora of the Malayan Peninsula* [Monocotyledons], by H. N. Ridley; *The Genus Meliola in Porto Rico*, by F. L. Stevens; *Voorbereidende Onderzoekingen ten dienste van de Selektie der Theeplant*, by C. P. Cohen Stuart; and *The Flowering Plants of Africa*, by F. Thonner.

The following have also been received: *Quinze cents Plantes dans l'Inde*, by A. D. Achart, from W. C. Worsdell; *Sleeping Sickness* . . . *in Principe, Portuguese West Africa*, by B. F. Bruto da Costa and others, translated by Lieut.-Col. J. A. Wyllie, from the translator; *Notes on Nigerian Trees and Plants*, by E. W. Foster, and a *Report on the Afforestation of Togo* . . . by A. H. Unwin, from the Secretary, Southern Provinces, Nigeria; *Flora of the Carboniferous of the Netherlands and*

adjacent regions, vol. i., by R. Kidston and W. J. Jongmans, from Mr. Clement Reid; *Transactions of the Third International Congress of Tropical Agriculture*, vol. i., from the Organising Secretaries; *The Smuts of Australia*, by D. McAlpine, from the Government of Victoria; *Tratado elemental de Botanica adaptado al estudio de le Flora de la America equinoccial*, by C. C. Marquez, from Mrs. F. Tracey, and *Prehistoria y viajes* [including *Flora Colombiana*], by the same author, from Mr. J. M. Vargas Vergara; *Flora of Saghalin* (in Japanese), by K. Miyabe and T. Miyake, from the Governor; *Contribution a l'Etude du Genre Pulmonaria*, by P. Parmentier (type-written), from Mr. C. C. Lacaita; La Science française, a work in two volumes, published on the occasion of the International Exhibition, San Francisco, 1915, from the Director of the National Office of French Universities and Schools; and *The Genus Phoradendron: a monographic revision*, by W. Trelease, from the University of Illinois.

The establishment is indebted to authors, editors, and others for numerous publications which it is not possible to specify in this note, but a complete list of the additions to the library for the year 1916, whether obtained by presentation, exchange, or purchase, will form Appendix II. to the *Kew Bulletin*, 1917.

Additions to the Herbarium during 1916.—During the year about 12,000 specimens were received as donations or exchanges, in addition to two large Tropical African collections, and 8260 acquired by purchase. During 1916, 775 specimens were received on loan. The principal collections are enumerated below:—

Europe.—*Presented*: British seeds, by Messrs. T. A. Sprague and W. B. Turrill.

Purchased: Dr. J. W. Ellis, British Fungi. Dr. E. G. Gilbert, British Rubi. H. Sudre, Herbarium Hieraciorum, fasc. 5-6.

Orient.—*Presented*: Persian lichens, by Dr. O. Stapf.

Atlantic Islands.—*Presented*: Tenerife, by Dr. G. V. Perez.

China and Japan.—*Presented*: Chekiang (F. N. Meyer), by the United States Department of Agriculture.

Purchased: China, E. H. Wilson and C. K. Schneider, and Japan, E. H. Wilson, through Prof. C. S. Sargent.

India.—*Presented*: Madras, by the Madras Government Herbarium, through Mr. J. S. Gamble; Madras, by Mr. C. E. C. Fischer and Prof. P. F. Fyson; Gwalior, by Miss E. M. Saunders; Ceylon, by Mr. A. R. Venning; Andamans, by Mr. C. E. Parkinson, through Mr. R. S. Hole; Malay Peninsula, Kedah Peak, by Messrs. H. C. Robinson and C. Boden Kloss, through Mr. H. N. Ridley; Malay Peninsula, various, by Mr. I. H. Burkill.

Malaya.—*Presented*: Siam, by Dr. A. F. G. Kerr, Khun Winit Wanadorn and Phra Vanpruk.

Australia.—*Presented*: New South Wales, by Mr. W. Greenwood; Western Australia, by Dr. F. Stoward and (Dr. Alexander Morrison) by the Royal Botanic Garden, Edinburgh.

Tropical Africa.—*Presented*: Sierra Leone, by Messrs. C. E. Lane-Poole and K. Burbidge; British East Africa, by Mr. W. J. Dowson; Uganda, by Messrs. R. Fyffe and R. A. Dummer; Nyasaland, by Mr. J. M. Purves; Rhodesia (Mr. A. J. Teague and the Rev. F. A. Rogers), by the Bolus Herbarium; South-West Africa, by Dr. Hans Schinz.

South Africa.—*Presented*: Percy Sladen Memorial Expedition, Keepmanskop to Windhoek, 1915-16 (Prof. H. H. W. Pearson) and from various localities, by the Bolus Herbarium; Basutoland (Mrs. A. Dieterlen) and other localities, by the South African Museum; Matabeleland (Rev. F. A. Rogers), by the Bolus Herbarium.

Purchased: Kentani Fungi, Miss A. Pegler.

North America.—*Presented*: British Columbia, Dry Belt, by Miss E. M. Warren; United States and Canada, by Prof. C. S. Sargent; "American Grasses" cent. 3–4 (including some tropical specimens), by the United States Department of Agriculture.

Purchased: Collins, Holden and Setchell, Phycotheca Boreali-Americana, fasc. 42-43; G. W. Stevens, Oklahoma.

Central America.—*Presented*: Mexico, (Frères G. Arsène and Nicolas), by Prince R. Bonaparte; Socorro Island, by Mr. Scoresby Routledge.

West Indies.—*Presented*: Various islands, by the New York Botanical Garden; Jamaica, by Mr. H. N. Ridley; Porto Rican Fungi, by Mr. F. L. Stevens.

South America.—*Presented*: Colombia, by Mr. M. T. Dawe and Mrs. F. Tracey; Patagonia, by Mr. Scoresby Routledge.

Dr. E. G. Gilbert's collection of British Rubi consists of more than 1000 sheets, representing many critical forms of which he had made a special study. Dr. G. V. Perez has continued to send critical species from Tenerife. Three important collections of Chinese plants have been acquired, one made in Chekiang by F. N. Meyer and received through the U.S. Department of Agriculture, the others made by Mr. E. H. Wilson and Mr. C. K. Schneider respectively were forwarded by Prof. C. S. Sargent, from whom also Wilson's Japanese collection has been obtained. Plants from the Madras Government Herbarium have been presented through Mr. J. S. Gamble, who is working out the "Flora of Madras." The plants collected by Messrs. H. C. Robinson and C. B. Kloss on Kedah Peak have been worked out at Kew by Mr. H. N. Ridley, whose report on them, with descriptions of new species, has been published in the *Journal of the Federated Malay States Museums*, vol. vii. pp. 37-58. Mr. I. H. Burkill has sent, amongst other things, specimens of Dioscoreas cultivated at Singapore. Dr. A. F. G. Kerr continued to send Siamese plants until he left Siam for service as an officer

of the Royal Army Medical Corps. Dr. F. Stoward has contributed additional material from Western Australia, and further consignments of the late Dr. Alexander Morrison's collection from the same region have been presented by the Royal Botanic Garden, Edinburgh. Mosses from New South Wales have been received from Mr. William Greenwood. Tropical Africa, as has been the case for some years, has furnished a large amount of material; in addition to that received from regular correspondents, a large collection has been received from German East Africa and another has been obtained from the Cameroons. Dr. Hans Schinz has presented an interesting collection of varieties of *Sorghum* from South-West Africa. Specimens collected by Prof. H. H. W. Pearson and others during the various Percy Sladen Memorial Expeditions in South Africa have been presented by the Bolus Herbarium. West Indian plants collected by Dr. N. L. Britton, Mr. W. Harris, and others have been presented by the New York Botanical Garden. Mr. H. N. Ridley has presented a set of the plants collected by him last winter in Jamaica. Mr. M. T. Dawe, Director of Agriculture, has sent many specimens collected during his tours in Colombia. Mr. Scoresby Routledge has presented the specimens collected during his cruise to Southern Patagonia, Socorro Island and Easter Island. In addition to dried specimens, a set of 293 water colour drawings of orchid flowers from the collection of Mr. J. Leemann was purchased at the Royal Horticultural Society's Red Cross Sale.

Black Rust of Wheat.—Prof. A. H. Reginald Buller, Professor of Botany, Winnipeg, sends us the following particulars as to the destruction of wheat in North America due to Black Rust: "The Black Rust has done enormous damage to our wheat crop in Canada and the United States. I have carefully looked into the figures at the Winnipeg Grain Exchange. Early in July, the wheat estimate for this year's crop was from 275 to 300 million bushels; the estimate now is between 150 and 175 million bushels. It is well within the mark to say that this year the depreciation of the wheat crop, owing to the attacks of rust, has been not less than 100 million bushels. This loss is that suffered in our three prairie provinces of Alberta, Saskatchewan, and Manitoba. In the Central States of the United States of America, such as the Dakotahs and Minnesota, the loss has been equally great. The poor Wheat crop in North America is affecting the War, for the British Government is having to send to Australia for supplies and thus using up tonnage which might otherwise have been free. The Rust Fungus is thus once more demonstrating that it can be a feature of high political and social importance."

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ROYAL BOTANIC GARDENS, KEW.

BULLETIN

OF

MISCELLANEOUS INFORMATION.

No. 2] [1917

VI.—THE BRITISH SPECIES OF PHOMOPSIS.

W. B. Grove.

(With Plates.)

Saccardo, in his Sylloge, 1884, vol. iii, p. 66, suggested that one of the sections into which the vast genus *Phoma* could conveniently be subdivided might be called *Phomopsis*—"perithecio subastomo depresso, basidiis demum uncinatis"—and added that the species of this section were probably all spermogonia of the ascophorous genus *Diaporthe*. At that time the real basis of this subdivision was imperfectly understood; it has since been worked out more fully, especially by Diedicke (Annal. Mycol., 1911, ix. 8), and it is now seen that, so far from being a section of *Phoma* separated by only slight differences, *Phomopsis* is in fact a very distinct genus with well-marked characters.

The typical pycnidium of *Phoma* is somewhat globose or lens-shaped, thin-walled, formed of rather loose olivaceous-brown or blackish pseudoparenchymatous tissue, which is only one or two cells thick and surrounds the pycnidial cavity similarly on all sides. It has a more or less marked ostiole or pore, often papillate, through which, when placed in water, the mature spores issue in those long curling strings with which all micro-mycologists are familiar, while the sporophores are very short, oftentimes barely perceptible or in age totally obsolete.

The typical *Phomopsis*, on the contrary, is rarely or never globose, when mature, and has the internal cavity enclosed by a heterogeneous wall; for it is floored below by a "proliferous stratum" several cells thick, composed of very minute faintly-coloured cells, while the upper half, in its perfect state, is roofed by a dense layer, also many cells thick, of very dark minute closely-packed cells, pierced usually about the summit by an ostiolar passage, often wide and irregular, which does not allow the spores to issue forth in curling tendrils with the same regularity as in *Phoma*. The sporophores which line the interior are long, flexuous, subulate, acicular, or cylindrical, densely crowded and much more permanent than those of *Phoma*; many of them, in fact, can always be seen under the microscope with the single apical spore still attached. The spores are lanceolate- or oblong-fusoid, more or less acute at the ends, hyaline,

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most often biguttulate, and seldom exceeding 10 μ in length or 4 μ in breadth; the guttules also are generally small compared with the size of the spore, much more so than in the average spore of *Phoma*, and they are also more distant from the extreme ends than is usual in that genus. The cavity of the pycnidium is sometimes more or less divided into spurious chambers by inward protrusions of the proliferous stratum, but this is not universal or essential, and is found also occasionally in *Phoma*. When these protrusions become more decided the genus *Phomopsis* verges upon *Fusicoccum*, but this latter has typically larger spores. It would be a mistake, however, to merge the two genera into one; the idea prevalent in some quarters that valid genera must always be demarcated by unmistakable characters is a survival from pre-Darwinian times.

One more peculiarity of *Phomopsis* is hinted at in Saccardo's words "basidiis uncinatis." When the contents of a crushed pycnidium are examined, there are often found among the typical spores some long filiform bodies which are more or less curved or arcuate, or hooked at one end after the fashion of a walking-stick. Saccardo considered these to be the sporophores (basidia), although how spores could legitimately be borne on the down-turned ends of such supports he did not explain. Other investigators have described them as a second kind of spore, exactly similar to those assigned to the genus *Phlyctaena*. It seems probable that both explanations are correct; that is to say, there is in some species of *Phomopsis*, if not in all, a second filiform kind of spore, borne on sporophores, which are in general shorter than those which bear the fusoid spores, but also the long acicular sporophores of the latter can break away from the hymenium, and then become more curved than when *in situ*, or even hooked. Diedicke called the typical fusoid spores the A-spores, and the long filiform ones the B-spores. Von Höhnel separated those few species in which both forms of spore were known to occur into the genus *Myxolibertella*, but it is better to consider these as merely a part of *Phomopsis*. When the B-spores occur, a section shows them in serried ranks, standing more or less parallel and erect on their sporophores; when only a few filiform structures are seen scattered among the fusoid spores, they are usually nothing but the transformed sporophores.

The following species may be considered to have both A- and B-spores:—

P. ambigua (*P. Mali*).
P. Arctii.
P. aucubicola.
P. Cacti.
P. Coronillae.
P. cryptica.
P. Dulcamarae.
P. Herminierae.
P. japonica.
P. Lonicerae.
P. petiolorum.
P. Phytolaccae.
P. Ryckholtii.
P. scobina.
P. Solani.
P. Sophorae.
P. tamicola.
P. velata.

Diedicke asserts that the A-spores are always borne on long sporophores, and the B-spores on special shorter ones, without intermediate links. Bubák states that the A-spores are on nar-

row ampulliform sporophores, and the B-spores on short thickish conical ones. Von Höhnel finds the sporophores more or less alike in both cases. The latter statement seems to represent the truth in most of the cases here investigated, though the B-spores always have shorter sporophores. Diedicke also tries to make out that the A-spores occur in pycnidia of a different shape from those containing the B-spores, but for this contention there seems to be little or no ground.

The description given above of the mature pycnidium would be misleading without further explanation. For, when the pycnidium is young, it may be incomplete above; in fact, in that case in some species the fungus would seem to belong to the *Melanconiales*, being much of the nature of a *Gloeosporium*. It is this state which Von Höhnel describes, and it may contain either A- or B-spores. At this time, however, the epidermis of the host is usually stained brown above the proliferous stratum, as one may find it in some states of *Leptothyrium* when their shield-shaped pycnidium is as yet imperfect. It is generally not till later that the thick pycnidial wall which surrounds the mouth of the *Phomopsis* is fully formed; in the end, again, this thickened mass sometimes easily drops out, leaving merely a pale cavity in the tissue lined with the spores and sporophores. The discoloured area of the epidermis is in many species of *Phomopsis* clearly visible as a halo round the ostiole of the fungus.

The belief that the species of this form-genus are pycnidial stages of *Diaporthe* is founded chiefly upon the fact that some of them, *e.g.*, *Diaporthe Arctii*, are found habitually with the two states in close association; and in certain other cases the groups of pycnidia are often surrounded by that same sinuous dark line (marking the outer boundary of a patch of mycelium) which is characteristic of certain sections of *Diaporthe*. Proofs by culture seem to be altogether non-existent, but more than half of the British species can be reasonably connected with the genus, on one or both of these two grounds.

Hitherto *Phomopsis* has been ignored by all British mycologists, but during the past year the large number of British specimens preserved in the Herbarium at Kew under the genus *Phoma* have been examined, with the result that the following species of *Phomopsis* are found to occur in this country. The names are arranged alphabetically. Only the spores and sporophores, of which knowledge has been very imperfect, are in general described here, as the macroscopic aspect is usually correctly given in the original account, but complete descriptions will appear in a work on the British *Coelomycetes*, i.e., *Sphaeropsidales and Melanconiales*, now in course of preparation. There are in the Herbarium also many foreign species belonging to the genus, but at present classed under *Phoma*, which it is hoped to treat in a similar manner at a later date. In what follows localities are given only when the species has not been previously recognised as British. Some proposed new species are added at the end.

Phomopsis, *Sacc.* Annal. Mycol. 1905, iii. 166.

Pycnidia lens-shaped, conical, pustular, or rarely subglobose,

usually depressed and with a broader base; when mature, texture everywhere several cells thick, below more or less hyaline, but tinged in the lower layers with pale olivaceous or smoke colour, above thicker, darker and brown or blackish towards the outside; provided with a decided ostiole or merely pierced by a pore, sometimes even mouthless, or opening by a slit or irregular orifice; internal cavity more or less divided at times by protrusions of the proliferous layer. Spores mostly fusoid with subacute extremities, but occasionally tending towards ellipsoid with narrowed ends, or even oblong, usually biguttulate, hyaline; sporophores filiform, linear, subulate, or ampulliform, when long often curved, usually longer than the spores, densely crowded and more or less permanent.

Besides these A-spores, a few species produce also, usually in younger and less perfect pycnidia, but sometimes in similar or even in the same pycnidia, another spore-form, on sporophores which can be more or less like those just mentioned, though generally shorter and at times very short and papilliform. These B-spores are long and filiform, often curved, arcuate, S-shaped, or hooked at the upper end like a walking-stick. Many species assigned to *Phlyctaena* are nothing but the pycnidia containing the B-spores, see Nos. 28, 58, 67, 68, 76.

The two most distinctive features of the genus *Phomopsis* are (1) the permanent sporophores, (2) the nature of the pycnidium, which bears little resemblance to that of a typical *Phoma*, and in fact is so different that a practised eye can often distinguish them with a hand-lens or even without assistance.

The chief accounts of the genus given since Saccardo are:—

Diedicke, Kryptogamenflora der Mark Brandenburg, Pilze, vol. ix, p. 238.

Diedicke, Annal. Mycol., 1911, ix. 8, "Die Gattung Phomopsis," with plates 1-3.

Von Höhnel, Fragmente zur Mykologie, no. 87, pp. 32-3, May, 1906.

Traverso, Flor. Ital. Cryptog. Part I, Fungi, vol. ii, fasc. 1, October, 1906.

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1. **Phomopsis Achilleae,** *v. Höhn.* Fragm. zur Mykol. no. 87, p. 32. *Phoma Achilleae,* Sacc. in Mich. ii. 616.

Spores elliptic-fusoid, 8-10 × 2·5-3 μ; sporophores acicular subulate, 20-26 × 1-1·5 μ. (Fig. 1.)

On dead stems of *Achillea Millefolium.* Probably the pycnidium of *Diaporthe orthoceras*, Nits. f. *Achilleae.* Undoubtedly British, but the specimens from Kew Gardens, referred to this, are *Diplodina Millefolii*, Allesch., having a true *Phoma*-like pycnidium, obsolete sporophores, spores not in the least degree fusoid and at length faintly 1-septate.

2. **P. albicans,** *Syd.* Mycoth. Germ. no. 1012. *Phoma albicans,* Rob. in Ann. Sci. Nat. 1849, xi. 284.

Spores elliptic-fusoid, rather acute at the ends, 8-11 × 2-2·5 μ; sporophores subulate, frequently curved, up to 15-16 × 3 μ. (Fig. 2.)

On dead peduncles of various *Compositae*, especially of *Leontodon* and *Hypochoeris*. Stated to be the pycnidium of *Pleospora albicans*, but this is unlikely, since it is a distinct *Phomopsis;* the pycnidia are crowded without order on bleached spots.

3. **Phomopsis ambigua,** *Trav.* Flor. Ital. Crypt. 1906, Fung. ii. 266. *Phoma ambigua*, Sacc. in Mich. i. 520.

Spores fusoid, often more pointed at one end, 8-10 × 2·5-3 μ; sporophores filiform or subulate, 12-20 × 1-1·5 μ. (Fig. 3.)

On twigs of *Pyrus communis;* possibly also on *P. Malus*. The pycnidium of *Diaporthe ambigua*, Nits.

4. **P. Amelanchieris,** *Grove*. *Phoma Amelanchieris*, Cooke in Grevill. xiii. 93.

Spores subfusoid, obtuse at apex, 8-9 × 2-2·5 μ; sporophores subulate, curved, 15-20 μ long. (Fig. 4.)

On branches of *Amelanchier*.

5. **P. Arctii,** *Trav.* l.c. p. 226. *Phoma Arctii*, Sacc. in Mich. ii. 340. Grove, in Journ. Bot. 1916, liv. 187, pl. 542, f. 5.

Spores ellipsoid-lanceolate, rather acute at the ends, 7-9 × 2·5-3 μ; sporophores crowded, more or less subulate, 20-25 × 1·5 μ. (Fig. 5.)

On dead stems of *Arctium Lappa*. Almost certainly the pycnidium of *Diaporthe Arctii*, Nits., with which it is constantly associated. The pycnidial wall is often very imperfect or even non-existent in the upper part. For a long time I could find no B-spores, such as Sydow found, but after examining scores of pycnidia I at length found some of the usual kind, 17-23 × 0·75-1 μ. A very typical *Phomopsis*.

6. **P. Asteriscus,** *Grove*. *Phoma Asteriscus*, Berk. in Ann. Nat. Hist. 1850, v. 368.

Spores oblong-ellipsoid, scarcely acute at the upper end, 7-8 × 2-2·5 μ; sporophores cylindrical, often arcuate, 12-20 × 1-1·25 μ. (Fig. 6.)

On dead stems of *Heracleum Sphondylium*. Even in his original description (l.c.) Berkeley perceived the characters which mark this species as distinct from the ordinary *Phoma*, and an investigation of the original specimens (Guernsey, Rev. T. Salwey) and many others shows that it is distinctly a *Phomopsis*, possibly the pycnidium of *Diaporthe Berkeleyi*, Nits.

7. **P. Aucubae,** *Trav.* l.c. p. 243. *Phoma Aucubae*, Westd. Exs. no. 1373. *Phoma insularis*, C. & M. in Grevill. xvi. 6 (*non* Speg.).

Spores ellipsoid or somewhat fusoid, often acute at the ends, 6-9 × 2-2·5 μ; sporophores cylindrical, 10-20 × 1·5 μ.

On dead twigs and leaves of *Aucuba japonica*. The form on the twigs (f. *ramulicola* Sacc. = f. *ramicola* Oud.) is undoubtedly a true *Phomopsis*, the pycnidium of *Diaporthe Aucubae*, Sacc.; and so far as can be seen from several specimens of Westendorp (no. 1373) examined, on the leaves, they are identical with those on the twigs in every respect. Cooke and Massee's specimens of

P. insularis are only *P. Aucubae*, where the ascophorous stage, to which the circumscribing black line belongs, is beginning to be formed. There is no other difference.

8. **Phomopsis Beckhausii,** *Trav.* l.c. p. 270. *Phoma Beckhausii*, Cooke in Grevill. xiii. 91.

Spores sublanceolate, 8-10 × 2-2·5 μ.

On dead branches of *Viburnum Lantana*, in company with young *Diaporthe Beckhausii*, Nits. According to von Höhnel *P. tinea*, Sacc. is identical with *P. Beckhausii*.

9. **P. Cacti,** *Grove*. *Phoma Cacti*, Berk. Plants Port. Welw. 1853, p. 12.

Spores oblong-ellipsoid, subacute at the ends, 6-8 × 1·5-2 μ; sporophores cylindrical, crowded, about as long as the spore or twice as long. (Fig. 7.)

On dead stems of *Cactus*. The British specimens examined (Lauderdale House, Highgate) are a true *Phomopsis;* those from Portugal (Crypt. Lusit. no. 72) are the same, but in them were found large numbers of filiform hooked spores, 18-20 × 0·75 μ, in the same pycnidia with the ellipsoid spores—these Berkeley saw and called (l.c.) "filiform sporophores." The variety *Opuntiae* assigned to this species by Saccardo (Syll. iii. 138) must be something different, being apparently not a *Phomopsis*.

10. **P. Calystegiae,** *Grove* *Phoma Calystegiae*, Cooke in Grevill. xiii. 94.

Spores sublanceolate, narrowed at each end, 7·5-8 × 2·5 μ.

On dead stems of *Calystegia sepium*. The pycnidium shows the change usual in a *Phomopsis*, from the early imperfect to the later fully-formed state.

11. **P. Caryophylli,** *Grove*. *Phoma Caryophylli*, Cooke in Grevill. xiii. 94.

Spores fusoid, somewhat obtuse at the ends, 7-9 × 2·25-2·5 μ; sporophores rod-shaped, 12-15 × 2 μ. (Fig. 8.)

On the calyces, peduncles and stems of cultivated *Dianthus*. The dead stems were in parts widely stained with black; evidently the pycnidium of an unknown *Diaporthe*.

12. **P. caulographa,** *Grove*. *Phoma caulographa*, Dur. et Mont. Flor. Alg., ex Sacc. Syll. iii. 126.

Spores oblong-fusoid, often inequilateral, acute at lower end, 7-8 × 2-2·5 μ; sporophores densely crowded, subulate, 10-12 × 1·5 μ, rising from a very fertile stratum.

On dead stems of *Chaerophyllum temulum*, Warwickshire, Worcestershire! The Yorkshire specimens recorded in the Naturalist (1904, p. 6) do not seem to be the same. I have seen no published authentic specimens, but mine have the black line, suggestive of a *Diaporthe*, very well developed, and the pycnidia aggregated in short linear series on the lanceolate blackish circumscribed spots. But they are not erumpent by a slit, and thus, apart from the spots, this species is different in habit from *P. striaeformis*, var. *hysteriola* (no. 66); the young pycnidial wall is of the usual imperfect character.

13. **Phomopsis Celastrinae,** *Grove.* *Phoma Celastrinae,* Cooke in Grevill. xiii. 92.

Spores lanceolate, attenuated at each end, 7-8 × 2-2·5 μ; sporophores straight, pointed 12-15 × 1·5-2 μ. (Fig. 9.)

On twigs of *Euonymus americanus*. Certain unattached larger spores, constricted in the middle, about 15 × 4 μ, were seen at the same time, but not on the sporophores. These were perhaps what Cooke meant in giving the size (l.c.) as "13 × 5 μ"; they might be immature ascospores of a *Diaporthe*.

14. **P. cinerascens,** *Trav.* l.c. p. 278. *Phoma cinerascens,* Sacc. in Mich. i. 521. *P. Ficus,* Cast. in Klotsch, Herb. Mycol. no. 1870. *Libertella ulcerata,* Massee in Gard. Mag. 1898, July 23, p.p.

Spores fusoid, somewhat obtuse at one or both ends, 6-8 × 2-2·5 μ; sporophores filiform-subulate, crowded, straight, faintly coloured below, 16-20 × 2 μ. (Fig. 10.)

On branches of *Ficus Carica*. The pycnidium of *Diaporthe cinerascens,* Sacc. A very typical *Phomopsis*, occurring on the bare wood as well as on the bark. Specimens under the name of *P. Ficus*, Cast. have identical spores and sporophores. Massee's type specimen of *L. ulcerata*, in Herb. Kew, is also the same fungus in the early state. i.e., with incomplete pycnidium, but with the same spores and sporophores, although he ascribes to it spores 55-60 × 4 μ. The length of the sporophores given by Diedicke and Allescher (7-8 μ) must be wrong; it is copied from Saccardo, and may be a misprint for 17-18 μ.

15. **P. cistina,** *Grove.* *Phoma cistina,* Cooke in Grevill. xiv. 3.

Spores cylindric-fusoid, obtuse at the ends, 6-8 × 2·5 μ; sporophores cylindrical, about twice as long.

On branches of *Cistus laurifolius*. Accompanied by numerous exolete perithecia, probably those of a *Diaporthe* (§ *Euporthe*), but no asci were seen and only a few 1-septate spores. The pycnidia were those of a *Phomopsis;* the long necks and the circumscribing black line, connected with them by Cooke, belong to the perithecia, which contained no *Phomopsis* spores.

16. **P. coneglanensis,** *Trav.* l.c. p 257. *Phoma coneglanensis,* Sacc. in Mich. ii. 240.

Spores oblong-fusoid, 7-8 × 2·5-3 μ; sporophores acicular, about 15 × 3 μ.

On fallen petioles of *Aesculus Hippocastanum*, accompanied by a *Diaporthe* without spores, probably *D. coneglanensis,* S. et S. In Italy and France it is recorded on the twigs also.

17. **P. Corni,** *Trav.* l.c. p. 268. *Phoma Corni,* Fckl. Symb. Myc. p. 207.

Spores cylindric-oblong or subfusoid, curved, 8-10 × 2-3 μ; sporophores subulate, or oblong and pointed, 10-12 μ long. (Fig. 11.)

On twigs of *Cornus alba,* associated with *Diaporthe Corni,* Fckl. It has a typical *Phomopsis* pycnidium. The reference by Cooke and Massee to *Cornus suecica* is a mistake.

18. **Phomopsis cryptica,** *v. Höhn.* l.c. p. 32. *Phoma cryptica*, Sacc. in Mich. i. 521.

Spores oblong-fusoid, 7-8 × 2·5-3 μ; sporophores subulate, curved, 13-20 by 1-1·5 μ.

On branches of *Lonicera*, Cheshire (Ellis)! The pycnidium of *Diaporthe cryptica*, Nits.; imperfect as usual above. The Kent specimens assigned to this species by Cooke are seen on examination to be not on *Lonicera*, but on *Tamus*, and to belong to no. 68.

19. **P. depressa,** *Trav.* l.c. p. 272. *Phoma depressa*, Sacc. in Mich. ii. 94 (*non* B. et Br.).

Spores lanceolate-fusoid, 8-10 × 2·5 μ; sporophores filiform, 20-28 × 1·5 μ.

On bark of dead twigs of *Syringa vulgaris*. The pycnidium of *Diaporthe resecans*, Nits. In the specimens examined the pycnidial wall was very imperfect, as in *P. Arctii*.

20. **P. Dipsaci,** *Grove*. *Phoma Dipsaci*, Cooke in Grevill. xiii. 94.

Spores sublanceolate or fusoid, somewhat obtuse at the ends, 8-9 × 2-2·5 μ; sporophores rod-shaped, crowded, 15-18 by 1·5 μ. (Fig. 12.)

On dead stems of *Dipsacus silvestris*. Accompanied by *Pleospora herbarum* and other ascophorous fungi, among which is one that is doubtless the beginning of a *Diaporthe*.

21. **P. Dulcamarae,** *Trav.* l.c. p. 246. *Phoma Dulcamarae*, Sacc. in Mich. ii. 272.

Spores fusoid, 8-10 × 2-2·5 μ; sporophores subulate, more or less curved, 12-15 × 2 μ.

On dry stems of *Solanum Dulcamara*. The pycnidium of *Diaporthe Dulcamarae*, Nits. Diedicke found in this species both A- and B-spores, the latter filiform, hooked, 25 × 1-1·5 μ.

22. **P. Durandiana,** *Died.* in Annal. Mycol. 1911, ix. 24. *Phoma Durandiana*, Sacc. et Roum. in Rev. Mycol. 1884, p. 29, pl. 45, f. 37.

Spores oblong-fusoid, sometimes more acute below, 7-9 × 2-3 μ; sporophores rod-like, crowded, about as long or longer.

On dead stems of *Rumex*. Probably the pycnidium of *Diaporthe maculosa*, S. et S. The epidermis is stained black over each spore-mass; just as in *P. Arctii*, there is little of a true pycnidial wall.

23. **P. exul,** *Grove*. *Phoma exul*, Sacc. in Mich. ii. 95.

Spores fusoid or cylindric-fusoid, subacute at the ends, 7-10 × 2-2·5 μ; sporophores very crowded, subulate, slightly curved, 12-18 × 2 μ.

On twigs of *Maclura aurantiaca*. The pycnidial stage of an unknown *Diaporthe*.

24. **P. fibrosa,** *v. Höhn. l.c.* p. 33. *Fusicoccum fibrosum*, Sacc. Syll. iii. 247.

Spores ellipsoid, acuminate below, 8-11 × 5 μ; sporophores filiform, 10-16 × 1·5 μ.

On dry branches and trunks of *Rhamnus catharticus*. Saccardo considered this to be the pycnidium of *Diaporthe fibrosa*, Fckl.

25. **Phomopsis glandicola,** *Grove*. *Phoma glandicola*, Lév. in Ann. Sci. Nat. 1846, v. 281. *Sporonema glandicola*, Desm. sec. Sacc.

Spores oblong-fusoid, 6-7 × 1·75-2 μ; sporophores simple, obclavate, 8-14 × 2·5 μ, arising from a smoke-coloured fertile stratum. (Fig. 13.)

On fallen Acorns. There are two forms of this, occurring together; in one the pycnidia are solitary and the spores as above; in the other the pycnidia are clustered and the spores measure 11-12 × 2·5-3 μ; sporophores nearly the same in both, but inclined to be narrower in the clustered form.

26. **P. Herminierae,** *Grove*. *Phoma Herminierae*, Cooke in Grevill. xiii. 93.

Spores lanceolate, somewhat rounded above, acute below, 7-8 × 2 μ; sporophores subulate, 12-15 by 3 μ. (Fig. 14.)

On bark of *Herminiera Elaphroxylon*. A typical *Phomopsis*, evidently introduced with the plant from Tropical Africa. With the A-spores were mixed large numbers of flexuous filiform B-spores, 30-40 × 1 μ, on shorter sporophores. Cooke gives the size of the fusoid spores wrongly as 10 × 3·5 μ.

27. **P. incarcerata,** *v. Höhn*. l.c. p. 33. *Phoma incarcerata*, Sacc. in Mich. ii. 95.

Spores fusoid, 8 × 2 μ; sporophores arcuate, 20 × 1 μ.

On dead branches of *Rosa canina*. The pycnidium of *Diaporthe incarcerata*, Nits.

28. **P. japonica,** *Trav*. l.c. p. 241. *Phoma japonica*, Sacc. in Mich. i. 521. *Phlyctaena Kerriae*, Karst.

Spores fusoid, 6-10 × 2-3 μ; sporophores filiform, flexuous 15-20 × 1·5 μ.

On twigs of *Kerria japonica*. The pycnidium of *Diaporthe japonica*, Sacc. The black line, mentioned by Saccardo as sometimes bordering the groups of pycnidia, belongs rather to the ascophorous stage; there is no trace of it in the early pycnidial stage.

29. **P. juglandina,** *v. Höhn*. l.c. p. 32. *Phoma juglandina*, Sacc. in Mich. i. 521.

Spores fusoid, 8-12 × 2·5-3·5 μ; sporophores filiform, curvulous, 15-25 × 1-1·5 μ.

On the bark of branches of *Juglans regia*. The pycnidial stage of *Diaporthe juglandina*, Nits. The Kew specimens are rather imperfect, but seem to belong to this species, at least in part. *Phoma Juglandis*, Sacc. Syll. iii, 152, on the nuts, may well be the same species, but no specimens have been seen.

30. **P. Landeghemiae,** *v. Höhn*. l.c. p 33. *Phoma Landeghemiae*, Sacc. Syll. iii. 71.

Spores subfusoid, nearly always straight, 5-8 × 2-2·5 μ; sporophores densely crowded, rod-shaped, 12-13 × 1·5 μ. (Fig. 15.)

On twigs of *Philadelphus coronarius*. The pycnidium of *Diaporthe Landeghemiae*, Nits.

31. **Phomopsis Lebiseyi,** *Died.* in Annal. Mycol. 1911, ix, 25, pl. 1, f. 12. *Phoma Lebiseyi*, Sacc. in Mich. i, 257.

Spores ovoid-fusoid, 8-10 × 3 μ; sporophores subulate or filiform, up to half as long again.

On branches of *Negundo aceroides*. The pycnidium of *Diaporthe Lebiseyi*, Niessl. The spores are rather wider in proportion than in most species of the genus; the pycnidia are flat and broad, pseudo-locellate within, rather thick and even papillate towards the mouth, which is at length exposed by the rupture of the epidermis.

32. **P. Lirella,** *Grove.* *Phoma lirella*, Desm. in Ann. Sci. Nat. 1849, xi. 281.

Spores elliptic-fusoid, subacute at the ends, 7-8 × 2-2·5 μ; sporophores crowded, more or less cylindrical, 12-15 × 1 μ.

On dry decorticated stems of *Vinca minor*. Externally exactly resembling a species of *Leptostroma*.

33. **P. Lonicerae,** *Grove.* *Phoma Lonicerae*, Cooke Fung. Brit. i. 616.

Spores elliptic-fusoid, acute at both ends, 8-9 × 2·5 μ; sporophores subulate, 15 × 2-2·5 μ. (Fig. 16.)

On old stems of *Lonicera*. A most typical *Phomopsis*, but quite distinct from *P. cryptica*, v. Höhn. (no. 18). Filiform hooked spores of the usual kind, 25-30 μ long, were found in situ in some of the pycnidia, in company with the A-spores but on shorter sporophores. The wood is frequently stained black round the base of the pycnidia, which leave a whitish pit when they fall away.

34. **P. Lysimachiae,** *Grove.* *Phoma Lysimachiae*, Cooke in Grevill. xiii. 94.

Spores broadly lanceolate, 7-9 × 2·5-3 μ; sporophores linear, straight, a little longer than the spore.

On stems of *Lysimachia vulgaris*. Presumably the pycnidium of a *Diaporthe*, as it has the true *Phomopsis* characters.

35. **P. Malvacearum,** *Grove.* *Phoma Malvacearum*, Westd. exs. no. 1232. *P. Lavaterae*, Westd. Not. vi. 22.

Spores elliptic-fusoid, somewhat obtuse at the ends, 7-10 × 2-3 μ; sporophores filiform, densely crowded, 15-18 × 1·5 μ.

On stems of *Malva moschata*. On the Continent, it is recorded on Hollyhock and *Malva silvestris*, and other species of Malvaceae: it may not be different from *P. Ophites*, Trav. (see no. 81). I have not seen the British specimens; the description given above is derived from those published in Westd. exs. no. 1232. Saccardo (and of course Allescher) says "contents brownish," but this is not true of the spores, even in mass, only of the lower proliferous stratum. The pycnidium is as imperfect as that of *P. Arctii*. This species is not, as Allescher asserts, identical with *Phoma nebulosa*, Berk.

36. **Phomopsis Menispermi,** *Grove.* *Phoma Menispermi,* Peck in 24th Rep. State Mus. New York, 1872, p. 85. *P. sarmenticia,* Sacc. in Mich. ii. 94, 1880.

Spores oblong-fusoid, subacute at the ends, 7-10 × 2-2·25 μ; sporophores subulate, crowded, 20-25 × 1-1·5 μ. (Fig. 17.)

On dead branches of *Menispermum canadense.* The pycnidium no doubt, of an unknown *Diaporthe.* A comparison of the British specimens, which are a true *Phomopsis,* with those of *Phoma Menispermi* from Portugal (Roumeguère, 4461) makes it as certain as one can be, without seeing Peck's original specimens, that *P. sarmenticia,* Sacc. is the same as *P. Menispermi,* Peck. The agreement with Peck's short description is exact; his statement that the pycnidia, on falling out, leave little white pits is just what takes place and what one might expect with a *Phomopsis* where the pycnidium is deeply seated and is less perfectly formed below. A little area of the epidermis over each pycnidium is discoloured; the sporophores are unusually long even for a *Phomopsis,* reaching sometimes to 35 μ. The statement by Cooke, that the same species occurs on *Cocculus carolinianus,* cannot be confirmed.

37. **P. moricola,** *Grove.* *Phoma moricola,* Sacc. in Mich, i. 525.

Spores oblong-ellipsoid, slightly tapering below, somewhat curved, 8-9 × 2-2·5 μ; sporophores cylindrical, crowded, curvulous, 10-12 × 1·5 μ. (Fig. 18.)

On dead twigs of *Morus.* Possibly the pycnidial stage of *Diaporthe Mori,* Berl. The pycnidium is that of a typical *Phomopsis;* it is sometimes accompanied by *Diplodia Mori,* Westd.

38. **P. Mulleri,** *Grove.* *Phoma Mulleri,* Cooke in Grevill. viii. 8.

Spores narrowly ellipsoid, subacute at the ends, often curved, 8-10 × 2-2·5 μ; sporophores acicular, crowded, curvulous, 15 × 1 μ.

On branches of *Rubus fruticosus, R. idaeus.* This species should be compared with *Phomopsis insignis* Trav. l.c. p. 246, which is the pycnidium of *Diaporthe insignis,* Fckl. I have found pycnidia of exactly the same character intimately mingled among perithecia of *Sphaerulina intermixta,* Sacc., which is the same as *S. abbreviata,* Cooke; so far as close association goes, it was just as likely that they should be the early stage of the *Sphaerulina,* as that *Hendersonia Rubi* should be so.

39. **P. nitidula,** *Grove.* *Phoma nitidula,* Sacc. in Mich. ii. 96.

Spores broadly fusoid, subacute at the ends, 7-8 × 2 μ (10-11 × 2-2·5 μ, Sacc.); sporophores filiform, about 15 × 1·5 μ.

On stems of *Scrophularia nodosa.* The pycnidium of an unknown *Diaporthe* (*?D. Tulasnei*); see no. 76.

40. **P. occulta,** *Trav. l.c.* p. 221. *Phoma occulta,* Sacc. Syll. iii. 150.

Spores narrow-oblong or somewhat obovoid, acute at base, curved in profile view, 9-11 × 2-2·5 μ (7 × 3 μ, Sacc.); sporophores crowded, filiform, usually straight, about 15 × 1 μ.

On scales of cones of *Picea excelsa*, Malvern and Dolgelley (Ellis)! The pycnidium of *Diaporthe occulta*, Nits., which has previously been recorded as British. The spores resemble much those of *Cytospora stictostoma*, Grove, but are longer and there is no cytosporoid stroma (as in that species), though the part of the scale where the pycnidia occur tends to be stained with black. The pycnidium is imperfect above.

41. **Phomopsis petiolorum,** *Grove.* (?) *Phoma petiolorum*, Desm. in Ann. Sci. Nat. 1847, viii. 16.

Spores fusoid-oblong, more acute below, 7-8 × 2-2·5 μ; sporophores subulate, inflated below, 12-15 × 2·5-3 μ. (Fig. 19.)

On fallen petioles of *Robinia Pseudacacia;* recorded also on petioles of *Cytisus* and *Gleditschia*, in other countries. Saccardo gives the sporophores as "filiform, 20-23 × 1 μ," but these probably represent B-spores. There seems no reason why this form on *Robinia* should not be considered identical with *Phomopsis Pseudacaciae*, Trav., which is found on the branches of *Robinia*, and is the pycnidium of *Diaporthe fasciculata*, Nits. The form on *Sophora*, sometimes included here, belongs to *P. Sophorae* (see no. 63). Probably all these "species" on petioles are merely forms of those on the branches of the same plant: see nos. 16 and 69. *Phoma petiolorum*, Fckl. (Symb. Myc. p. 132) is quite different, and appears to be the pycnidium of a *Pleospora;* I have found both the *Phoma* and the *Phomopsis* on *Robinia* petioles, the former with a *Pleospora* akin to *P. herbarum.*

42. **P. Phaseoli,** *Grove.* *Phoma Phaseoli*, Desm. in Ann. Sci. Nat. 1836, vi. 247.

Spores elliptic-oblong or subclavate-fusoid, rather acute at the ends, 7-9 × 2·5-3 μ; sporophores cylindric-subulate, about 15 × 2-2·5 μ. (Fig. 20.)

On old stems of *Phaseolus*. No doubt the pycnidium of a *Diaporthe*, possibly *D. Phaseolorum*, C. et E. The specimens of Desmazières (Pl. Crypt. no. 843) seem to be the same as the British ones, but younger; the pycnidium is often imperfect and they are in any case a *Phomopsis*, but the f. *Lepidii*, Sacc. is different.

43. **P. piceata,** *Grove.* *Phoma piceata*, Sacc. Syll. iii. 107. *Phoma picea*, B. et Br. in Ann. Nat. Hist. 1850, v. 370 (*non* Pers.).

Spores oblong-ellipsoid, subacute at the ends, straight or faintly curved, often irregular, 7-9 × 2-2·5 μ; sporophores linear, straight, 15-18 × 2 μ. (Fig. 21.)

On the under surface of dead Rose leaves. This is a doubtful species; the measurements have been taken from Berkeley's original specimens. The spores were often seen constricted as if about to become 1-septate, but they never became so. *Phoma*

picea (Pers.) Sacc. is also a *Phomopsis* (*Phomopsis picea*, v. Höhn.), though not British; therefore Berkeley's specific name cannot stand. The resemblance of *P. piceata* to *Ceuthospora concava*, Desm. (Ann. Sci. Nat. 1847, vii. 17) is very close, but the latter is much broader (about $2\frac{1}{2}$ times) and has different spores; nevertheless it is impossible not to suspect that they are mere forms of each other.

44. **Phomopsis Platanoidis,** *Died.* Krypt. Brand. Pilz. p. 242. *Phoma Platanoidis*, Cooke in Grevill. xii. 93.

Spores fusoid, rather acute at the ends, 7-8 × 2-2·5 μ; sporophores filiform, longer than the spore.

On twigs of *Acer Pseudoplatanus*. Cooke says that it was associated with *Calospora Platanoidis*, Niessl, and suggests that it is the pycnidium of that species, but analogy would make it rather to belong to a Diaporthe. The British specimens seem to incline somewhat towards *Fusicoccum*.

45. **P. Podophylli,** *Grove.* *Phoma Podophylli*, Cooke in Grevill. xv. 108.

Spores elliptic-fusoid, frequently biguttulate, 7-10 × 2·5-3 μ; sporophores rod-like, straight, 15-20 × 2 μ. (Fig. 22.)

On fading leaves of *Podophyllum*. No doubt the pycnidial stage of an unknown *Diaporthe*. Just as in *P. Arctii*, there is no true complete pycnidium. Other species of *Phomopsis* are known upon leaves (see nos. 7, 43, 65, 74), but such a habitat is rare.

46. **P. Polygonorum,** *Grove.* *Phoma Polygonorum*, Cooke in Grevill. xiv. 3.

Spores ellipsoid, somewhat obtuse at the ends, 6-7 × 2·5 μ; sporophores acicular, 10 × 2 μ.

On dry stems of *Polygonum cuspidatum*. Probably the pycnidium of an unknown *Diaporthe*. Cooke wrongly gives the size of the spores as 12 × 3 μ.

47. **P. Prunorum,** *Grove.* *Phoma Prunorum*, Cooke in Grevill. xiii. 92. *Phoma Pruni-lusitanicae*, Cooke l.c. p. 93. *P. Pruni*, Peck in 38 Rep. State Mus. p. 95.

Spores fusoid, subacute at the ends, 8-9 × 2-2·5 μ; sporophores cylindrical, 12-15 × 2 μ

On twigs of *Prunus Laurocerasus*, *P. lusitanica*. Possibly the pycnidium of *Diaporthe viridarii*, Sacc. Some authorities give the spores a greater width (Cooke, 4·5 μ; J. W. Ellis, 3-4 μ), but I find them as stated. When the twigs of *P. lusitanica* are dry, the epidermis around the pycnidia retains its colour, but there is no difference otherwise between Cooke's two species.

48. **P. pterophila,** *Died.* Krypt. Brand. Pilz. p. 255. *Sphaeria pterophila*, Nits, in litt. ad Fckl. *Phoma pterophila*, Fckl. Symb. Myc. p. 377.

Spores ellipsoid, subacute at the ends, 7-8 × 2·5 μ; sporophores subulate or filiform, curved or straight, 11-13 × 1-1·5 μ. (Fig. 23.)

On samarae of *Fraxinus excelsior*, but only on the thick part enclosing the seed, not on the wing. The pycnidium of *Diaporthe samaricola*, Phill. et Plow. At once distinguished from *Phoma samararum*, on the same habitat, by its larger size and the faint brown halo surrounding each pycnidium; the latter, moreover, occurs chiefly on the wing.

49. **Phomopsis pulla,** *Trav.* l.c. p. 244. *Phoma pulla*, Sacc. in Mich. ii. 96.

Spores oblong or ellipsoid, 7-8 × 2-3 μ; sporophores curved, 12-16 × 1 μ.

On dead branches of *Hedera Helix*. Often accompanied by *Diaporthe pulla*, Nits. of which it is undoubtedly the pycnidium. It is sometimes also found in company with *Diplodia Hederae*, Fckl.

50. **P. pustulata,** *Died.* in Annal, Mycol. 1911, ix. 28. *Phoma pustulata*, Sacc. Syll. ii. 91.

"Spores oblong, 10-13 × 3·5 μ; sporophores filiform, curved, 14 μ long."

On dead branches of *Acer palmatum*. The pycnidium of *Diaporthe pustulata*, Sacc. No specimens seen.

51. **P. quercella,** *Died. ibid. Phoma quercella*, Sacc. Syll. iii. 96.

Spores fusoid, acute at the ends, 8-12 × 2-3 μ; sporophores rod-shaped, 12-15 × 2 μ, arising from a yellowish fertile stratum. (Fig. 24.)

On twigs of *Quercus*. Presumably the pycnidium of an unknown *Diaporthe*.

52. **P. quercina,** *v. Höhn.* l.c. p. 33. *Fusicoccum quercinum*, Sacc. in Mich. ii. 345.

Spores cylindric-fusoid, gently curved, 7-10 × 1·5-2 μ; sporophores filiform, a little shorter than the spore.

On branches of *Quercus*, Malvern (Ellis)! Considered to be the pycnidium of *Diaporthe leiphaemia*, Sacc. (*Valsa leiphaemia*, Fr.). These British specimens are almost intermediate between *Fusicoccum* and *Phomopsis*. But there seems to exist also a form with larger spores (15-16 × 3-3·5 μ), and also of an intermediate size (10-14 × 3-3·5 μ), all otherwise very similar and representing a true *Fusicoccum*. The material available is not sufficient to decide the question, but the Malvern specimens are evidently the same as those which Fuckel assigned (Symb. Myc. p. 194) to his *Cryptospora leiphaemia*. No specimens from the other recorded British localities have been seen.

53. **P. Radula,** *Grove. Phoma Radula*, B. et Br. in Ann. Nat. Hist. 1850, v. 369.

Spores elliptic-fusoid, subacute at the ends, 9-10 × 2-3 μ; sporophores acicular, 15-20 × 2 μ. (Fig. 25.)

On dead twigs of *Platanus*. A true *Phomopsis*.

54. **Phomopsis Rhois,** *Trav.* l.c. p. 258. *Phoma Rhois,* Sacc. in Mich. ii. 340.

Spores elliptic-fusoid or oblong-fusoid, rather obtuse at the upper end, 7-10 × 2-2·25 μ; sporophores subulate, 12-15 × 1·5-2 μ.

On dead branches and peduncles of *Rhus typhina, R. radicans.* The pycnidium of *Diaporthe Rhois,* Nits. which sometimes accompanies it.

55. **P. Robergeana,** *Died.* in Annal. Mycol. 1911, ix. 29. *Phoma Robergeana,* Sacc. in Mich. i. 520.

Spores fusoid or lanceolate, straight or somewhat curved, 9-14 × 2-2·5 μ; sporophores filiform, 25-30 × 1·5 μ.

On twigs of *Staphylea pinnata.* Probably the pycnidium of *Diaporthe Robergeana,* Niessl.

56. **P. Rosae,** *Grove. Phoma Rosae,* Schulz, et Sacc. Micr. Slav. no. 46.

Spores narrowly ellipsoid, rather obtuse at the ends, straight, 7-8 × 2·5 μ; sporophores rod-shaped, 15-20 × 2 μ.

On prickles of *Rosa canina.* The pycnidium of an unknown Diaporthe; the pycnidial wall is formed below in the typical way. Cf. no. 27.

57. **P. rudis,** *v. Höhn.* l.c. p. 32. *Phoma rudis, Sacc.* in Mich. i. 257.

Spores elliptic-fusoid, subacute at the ends, 7-9 × 2 μ; sporophores densely crowded, filiform, straight, 20-24 × 1-1·5 μ.

On twigs of Laburnum. The pycnidium of *Diaporthe rudis,* Nits. The pycnidia are not depressed, but somewhat conical, and raise the epidermis considerably before bursting it open. Saccardo suggests that it afterwards develops into his *Rabenhorstia rudis;* this may be so, but the spores of the latter are oblong and blunt at the ends.

58. **P. Ryckholtii,** *v. Höhn.* l.c. p. 33. *Phoma Ryckholtii,* Sacc. Syll. iii. 70.

Spores obtusely fusoid, 5-9 × 2·5-3 μ; sporophores rather long.

On branches of *Symphoricarpus racemosus.* The pycnidium of *Diaporthe Ryckholtii,* Nits. There can be no doubt whatever that *Phlyctaena phomatella,* Sacc. var. *Symphoricarpi-racemosae* is the same species with the B-spores, while the form recorded above shows the A-spores.

59. **P. salicina,** *Died.* in Annal Mycol. 1911, ix. 30. *Phoma salicina,* Westd. ex Sacc. Syll. iii. 97.

Spores ellipsoid-oblong, somewhat obtuse at the ends, 6-7 × 2-2·5 μ; sporophores densely crowded, about as long.

On branches of *Salix babylonica, S. viminalis,* and other species. This has been supposed to be the pycnidial stage of a *Diaporthe,* but the British and foreign specimens under this name examined do not seem to be in agreement with this supposition.

60. **Phomopsis sambucina,** *Trav.* l.c. p. 269. *Phoma sambucina*, Sacc. in Mich. ii. 97.

Spores oblong-fusoid, subacute at the ends, 5-9 × 2·5-3 μ; sporophores acicular, 15-20 × 1·5-2 μ. (Fig. 26.)

On twigs of *Sambucus nigra*. The pycnidium of *Diaporthe circumscripta*, Otth.

61. **P. Sarothamni,** *v. Höhn.* l.c. p. 33. *Phoma Sarothamni*, Sacc. Syll. iii. 68. *P. Spartii*, Sacc. in Mich. i. 359.

Spores fusoid-oblong, acute at one end, 8-12 × 2-2·5 μ; sporophores filiform, more or less curved, 15-20 × 1-1·5 μ.

On dry branches of *Sarothamnus scoparius*. The pycnidium of *Diaporthe Sarothamni*, Nits. When fully formed this is very conspicuous. *P. Spartii*, Sacc. agrees exactly with the British specimens on Broom.

62. **P. scobina,** *v. Höhn.* l.c. p. 33. *Phoma scobina*, Cooke in Grevill. xiii. 92. *Myxolibertella scobina, v. Höhn.* in Annal. Mycol. i. 526.

Spores elliptic-fusoid, sometimes subclavate, 7-10 × 2-2·5 μ; sporophores subulate or cylindrical, occasionally curved or bent, 10-12 × 1·5 μ; B-spores about 20 × 1 μ. (Fig. 27.)

On twigs of *Fraxinus excelsior*. Frequently accompanied by *Diaporthe scobina*, Nits. of which it is the pycnidium. It is recorded in Yorkshire Fungus Flora on leaves of Ash, possibly in error.

63. **P. Sophorae,** *Trav.* l.c. p. 260. *Phoma Sophorae*, Sacc. Syll. iii. 67.

Spores oblong-fusoid, sometimes curved, often somewhat clavulate, 8-11 × 2-2·5 μ; sporophores cylindrical, rather obtuse, 15-20 × 2 μ.

On dead twigs of *Sophora japonica*. The pycnidium of *Diaporthe Sophorae*, Sacc. The pycnidia are sometimes arranged in little groups, surrounded by a narrow black line (significant of a *Diaporthe*), but this is frequently not present. The width of the spores is given by Saccardo as 3·5-4 μ, and the sporophores are said to be hooked, 25 × 0·5 μ; these latter are no doubt the B-spores which Diedicke found in the larger pycnidia, but of which no trace was seen in the British specimens or in the many foreign ones examined. Saccardo issued (Mycothec. Venet. 1547) a remarkable form of this species (var. *libricola*, Sacc.), which has the pycnidia arranged in lines, immersed in the bark of the trunk, and each surrounded by a black stain. The spores and sporophores, however, are as described above.

64. **P. Sorbariae,** *v. Höhn.* l.c. p. 32. *Phoma Sorbariae*, Sacc. Syll. iii. 75.

Spores oblong-fusoid, often rather blunt at the ends, 7-9 × 2·5 μ; sporophores cylindrical, a little longer than the spore or twice as long. Mixed with these in the same pycnidia were found occasionally B-spores, filiform, hooked, 20-25 × 1 μ. (Fig. 28.)

On dead branches of *Neillia opulifolia* and (?) *Spiraea japonica* (= *callosa*). The pycnidium of *Diaporthe Sorbariae*, Nits. In

some of the pycnidia there were large numbers of the filiform spores, which were seen both in situ (parallel, crowded, and intermixed with the A-spores) and loose among the spore-mass. They were of various shapes, flexuous, curved, arcuate, and hooked, but always filiform; their sporophores were but little different from those of the A-spores. This species may be considered the most typical *Phomopsis* of all those examined.

65. **Phomopsis stictica,** *Trav.* l.c. p. 276. *Phoma stictica*, B. et Br. in Ann. Nat. Hist. 1850, v. 370.

Spores fusiform-ellipsoid, acute at the ends, 7-8 × 2·5-3·5 μ; sporophores cylindrical, 10 × 1·5 μ.

On dead leaves, twigs, and branches of *Buxus sempervirens*. The pycnidium of *Diaporthe retecta*, Nits. The spores are broader than usual, and shaped like a "tip-cat"; those on the leaves are exactly the same as on the twigs.

66. **P. striaeformis,** *Grove.* *Phoma striaeformis*, Dur. et Mont. Fl. Alger. p. 603.

Spores elliptic-fusoid, slightly clavate at times, 7-9 × 2-2·5 μ; sporophores rod-shaped often curved, 15-18 × 2 μ. (Fig. 29.)

On twigs of *Kerria japonica*. It is recorded from the Continent also on *Cytisus* and *Sambucus*, but this is doubtful. This species forms short linear black flecks, arranged longitudinally on the stem, about 1 mm. long on the average, but also shorter or longer in some cases. The statement in the description that the sporophores are "very short" is not in accordance with the specimens issued by Desmazières (ser. ii. no. 59), in which they are as described above.

var. **hysteriola,** *Sacc.* in Mich. ii. 93. Grove, in Journ. Bot. 1916, liv. 188. *Phoma hysteriola*, Allesch. vi. 288.

Spores oblong-lanceolate, tapering downwards or even acute at the base, 6-9 × 2·25-3 μ; sporophores densely crowded, simple, subulate, as long as or longer than the spores, springing from a thick olive-brown stratum.

On the swollen part of dead stems of *Chaerophyllum temelum*, Cheshire (Ellis)! An evident *Phomopsis*, distinguished from the type by the pycnidia being erumpent in an *Hysterium*-like manner between the fibres of the stem. Saccardo described the spores as 4-guttulate; such spores were seen and a few were 3-guttulate, but the majority of the mature spores were always distinctly 2-guttulate. Allescher (who had not seen it or the type) made this variety a separate species on the ground of the longer sporophores; but this distinction falls to the ground when it is seen that the sporophores of the type can be much longer than the spores.

67. **P. subordinaria,** *Trav.* l.c. p. 232. *Phoma subordinaria*, Desm. in Ann. Sci. Nat. 1849, xi. 284. *Phlyctaena Plantaginis*, Lamb. et Fautr.

Spores oblong-fusoid, rather blunt at the ends, often curvulous, sometimes subclavate, 7-10 × 2-2·5 μ; sporophores rather short, up to 12 × 1·5 μ.

On dead scapes of *Plantago lanceolata*. The pycnidium of *Diaporthe adunca*, Niessl. There is at first no true pycnidium, merely the discoloured epidermis, but later there arises round the pore a thick smoky-brown sclerotial tissue, which at length falls out in the way previously described. On the Continent this species is recorded also on *P. major* and *P. media*. According to Diedicke it is a parasite, appearing as early as July, and often causing a sharp bend of the upper part of the attacked scapes, by which they are easily recognisable. These statements are not known to be true of the British specimens. The inclining of the spike is owing to the fact that the attack begins at the upper part of the green peduncle, which then leans over through the weakening of the support; afterwards the attack proceeds downwards. A true *Phoma* can, at times, also be found on the same peduncles.

68. **Phomopsis tamicola,** *Trav.* l.c. p. 233. *Phoma tamicola*, Cooke in Grevill. xiii. 95. *Phlyctaena vagabunda*, Desm. in Ann. Sci. Nat. 1847, viii. 16, var. *Tami*.

Spores fusoid, rather obtuse at the ends, 8-9 × 2·25-3 μ; sporophores linear-subulate, crowded, 15 × 1-1·5 μ; B-spores 20-25 × 1 μ.

On dry stems of *Tamus communis*. The pycnidium of *Diaporthe scandens*, Sacc. et Speg. There cannot be the slightest doubt that the *Phlyctaena* on *Tamus* is merely the earlier state of the *Phomopsis*, before the pycnidial wall is fully developed and when the filiform spores alone are being produced. Attempts, however, to find both forms of spore in the same pycnidium were unsuccessful.

The non-British *Phlyctaena vagabunda*, var. *Phytolaccae* is similarly the early state of *Phomopsis Phytolaccae*, Grove (*Phoma Phytolaccae*, B. et C.), which is a true *Phomopsis*. This early state is found in close company with the mature state, and is what is called by Saccardo (Syll. iii. 594) *Phlyctaena septorioides*, Sacc.

69. **P. velata,** *v. Höhn.* l.c. p. 33. *Phoma velata*, Sacc. in Mich. ii. 96.

f. *minor*, Sacc. Syll. iii. 92 = *P. communis*, Rob. in Herb. Desm. ser. ii. no. 693.

Spores oblong-fusoid, blunt at the ends 7-8 × 2-2·5 μ; sporophores cylindrical, up to 14 × 1·5 μ. (Fig. 30.)

On bark of *Tilia* spp. The pycnidium of *Diaporthe velata*, Nits. The typical form has longer spores (10-12 μ) and sporophores (20 μ). *Phoma communis*, Rob. seems to be a still smaller form on the twigs and petioles.

In the British specimens there were found, in similar (but not, so far as was seen, the same) pycnidia, large numbers of B-spores, filiform, flexuose or hooked, 16-20 × 1 μ, borne on short papilliform cells such as Diedicke describes and figures for *Phomopsis oblita*, Sacc. (Annal. Mycol. 1911 ix. 26, pl. 3, f. 4). In Desmaz. 693 the B-spores were found in abundance; in typical *P. velata*, Diedicke found only the A-spores.

70. **Phomopsis viridarii,** *Grove. Phoma viridarii*, Sacc. in Mich. ii. 96.

Spores more or less fusoid, straight or curvulous, 8-10 × 2·25-3 μ; sporophores cylindrical, 8-11 × 1·5 μ.

On twigs of *Magnolia grandiflora*. No doubt the pycnidium of a *Diaporthe*, since it is a *Phomopsis*, but with sporophores hardly longer than the spores.

71. **P. viticola,** *Grove. Phoma viticola*, Sacc. in Mich. ii. 92. *Phoma viniferae*, Cooke in Grevill. xiii. 92 (1885). (Non *Phoma viticola*, Sacc. Syll. iii. 110 = *P. vitea*, Sacc. l.c. 860 =*Sphaeropsis viticola*, Cooke in Grevill. xii. 22, quae *Macrophoma*.)

Spores elliptic-fusoid, subacute at the ends, usually straight, 7-10 × 2-2·5 μ; sporophores subulate, 10-12 × 2·5 μ.

On dead branches of *Vitis vinifera*. Possibly the pycnidium of *Diaporthe viticola*, Nits. *Phoma cordifolia*, Brun. Champ. Saint. vii. 4 (Sacc. Syll. x. 152) does not seem to differ from this *Phomopsis*, which may be found on the same rods with *Phoma Vitis*, Bon.

Species Novae.

72. **Phomopsis Aristolochiae,** *Grove*, sp. n.

Pycnidia dense sparsa vel gregaria, oblonga vel rotundata, convexa, immersa, dein prominula, primo tantum ostiolo erumpentia, 0·25-0·3 mm. longa, nigrescentia. *Sporulae* elliptico-fuseideaé, inaequilaterales vel subcurvatae, utrinque praecipue basi acutatae, biguttulatae, 9-10 × 2·25-2·75 μ; sporophorae bacillares vel subulatae, stipatae, plerumque rectae, circa 12-15 × 1-1·5 μ.

Hab. in caulibus emortuis *Aristolochiae Siphonis*, in Hort. Bot. Kew, Maio.

The pycnidium is here also very imperfect. At first it is entirely hidden beneath the epidermis, then it becomes erumpent by what looks like a minute black point (ostiole), the rest showing through the translucent epidermis as a convex blackish mass surrounding the black point; afterwards the whole of the upper part disappears and a wide-mouthed blackish-brown hollow full of spores is left. At this stage the fungus looks very like a *Gloeosporium*, such as *G. nervisequum*, but of course the spores and sporophores are very different. The many-layered mass of cells from which the sporophores originate ("proliferous stratum") is tinged as usual with pale olivaceous.

73. **Phomopsis aucubicola,** *Grove. Phoma lirelliformis*, Sacc. var. *aucubicola*, Brun. in Act. Soc. Linn. Bord. 1888, p. 15, extr. (?) Grove, in Journ. Bot. 1916, liv. 187, pl. 542, f. 4.

Pycnidia dense gregaria, nigra, innato-erumpentia, dimorpha, alia rotundata v. oblonga, pustuliformia, prominula, 0·5 mm. diametro, alia plus minusve transverse elongata, etiam lirelliformia, usque 3 mm. longa, circa 0·16 mm. lata, contextu *Phomopsidis*. *Sporulae* dimorphae, aliae ovoideo-oblongae vel subfusoideae, saepe biguttulatae, 7-12 × 2·5 μ, sporophoris subu-

latis, 9-15 × 2 μ, interdum longioribus suffultae, aliae filiformes, curvatae vel uncinatae, 20-30 × 0·75-1 μ, sporophoris similibus. (Fig. 31.)

Hab. in ramulis emortuis *Aucubae japonicae*, in Hort. Bot. Birmingham, Martio.

The two kinds of spores occurred often in the same pycnidium side by side, the B-spores as abundant sometimes as the others. The sporophores which had lost their spores frequently became elongated and acuminated so as to resemble at first sight the B-spores, but retained always the subulate base. The foregoing account, owing to examination of fresh specimens, differs slightly from that given in Journ. Bot. l.c.; whether the species is identical with Brunaud's variety is doubtful, but it is quite different from *P. Aucubae*, Trav. (no. 7).

It seems likely that this fungus is a parasite. In the Botanic Gardens a number of Aucubas have gradually died at intervals, beginning at the ends of some of the branches, and on the dead twigs the *Phomopsis* has been found; imperfect pycnidia occur on the living and still green branches, though no spores were found in them. The appearances suggest that the fungus having entered (how is not known), the mycelium gradually destroys the bast, cambium, medullary rays and pith; finally the cortex is destroyed, leaving the epidermis loosened; the spores are then produced on the dead twigs. It should be noted that *Phomopsis subordinaria* (no. 67) on *Plantago* and *P. Stewartii*, Peck on *Cosmos*, are also regarded as parasitic.

74. **Phomopsis Bloxami,** *Grove.* *Phoma Bloxami*, Berk. in Herb. Kew. *Vermicularia Eryngii*, Cooke in Grevill. (non Fckl.)

Pycnidia dense congregata, innata, glabra, 0·16-0·3 mm. diametro, nigra, epidermide circum circa nigrificata ostiolo minuto pertusa; contextu tenui parenchymatico fuligineo. *Sporulae* elliptico-fusoideae, ut plurimum utrinque acutatae, raro curvulae, plerumque eguttulatae, 10-12 × 1·5-2 μ (rarius 2·5 μ lat.)

Hab. in stipitibus foliisque *Eryngii maritimi*, Fleetwood, *A. Bloxam;* Scotland, *Greville*, Julio.

The smooth black patches by which the pycnidia are surrounded are very conspicuous.

75. **Phomopsis Cruciferae,** *Grove*, sp. n.

Pycnidia sparsa, lineari-lanceolata, parallele secus fibras stipitis disposita, epidermide tecta, dein rima erumpentia, usque 1 mm. longa, nigra. *Sporulae* oblongo-fusoideae, utrinque obtusiusculae. 7-8 × 2·5 μ; sporophorae cylindricae, rectae, 10-12 × 1·5 μ.

Hab. in stipitibus emortuis *Cruciferae* cujusdam, in Hort. Bot. Kew. Aprili.

76. **Phomopsis Solani,** *Grove.* *Phlyctaena maculans*, Fautr. in Rev. Mycol. 1896, p. 70.

Pycnidia densiuscule sparsa, nec in maculas discretas congregata, primo epidermide velata, ad 0·25 mm. diametro, globoso-depressa vel oblonga, nigra, ostiolo erumpente, halone nigrescente

cincto. *Sporulae* elliptico-fusoideae, utrinque vel saltem basi acutatae, biguttulatae, 7-8 × 2·5-3 μ; sporophorae cylindrico-subulatae, apice acutae, 10-15 × 1-1·5 μ; B-sporulae (in iisdem vel discretis pycnidiis) filiformes, curvatae vel uncinatae, 20-25 × 0·75-1 μ, sporophoris brevioribus (5-8 μ long.) subdigitali-formibus suffultae.

Hab. in stipitibus emortuis *Solani tuberosi*, Botley, Hants, *A. D. Cotton*, Jan.

The pycnidia are at first imperfect in the usual way, at length erumpent and pierced at the summit by a pore. In this species the subhymenial tissue is more fuliginous and softer (cell-walls less clearly marked) than in most other species; in the *Phlyctaena-state* exactly the same peculiarity is notable. In the imperfect state some of the pseudo-pycnidia had only A-spores, some only B-spores; in relatively few cases both kinds of spores were found in the same pycnidium.

P. Solani presents certain similarities to the description of *P. Tulasnei*, Sacc. (Annal. Mycol. i. 27), but shows also considerable differences, which entitle it for the present to be treated as distinct, until it shall be demonstrated that they are both pycnidia of *Diaporthe Tulasnei*, Nits. *Phlyctaena maculans* is described by Fautrey as having spores 35 μ long, on sporophores about 12 μ long, but there can be little doubt that it is identical with this species.

It should be noted that *P. nitidula* (no. 39) and *P. Aristolochiae* (no. 72) bear great similarity in certain aspects to *P. Solani*, and are also under suspicion of being possibly mere pycnidial stages of *D. Tulasnei*, but in the present state of knowledge it would be premature to unite all these under one name.

Species excluded for the present from the British List.

77. **Phomopsis Coluteae,** *Died.* in Annal. Mycol. 1911, ix. 22. *Phoma Coluteae*, Sacc. et Roum. in Mich. ii. 338.

Spores oblong-fusoid, 7·9 × 2·5-3 μ; sporophores oblong-lanceolate, faintly coloured, about as long as the spore.

"On branches of *Colutea arborescens*. Kew Gardens; Dalston." The Kew specimens, which are marked "forma minor, spores 5 × 3 μ, without nuclei," certainly do not belong to this species, but to *Coniothyrium Fuckelii*, which has spores reaching 5 × 3 μ; when young these spores are quite colourless, and may be easily mistaken for a *Phoma*, but never for a *Phomopsis*. The description given above is drawn up from French specimens (*Roumeguère*. 911), which are undoubtedly a *Phomopsis*, though with unusually short sporophores.

78. **Phomopsis Coronillae,** *Trav.* l.c. p. 240. *Phoma Coronillae*, Westd. Exs. no. 966.

"Spores ovoid-oblong, 7-8 × 3 μ; sporophores filiform, arcuate, 20 × 1·5 μ."

"On dead branches of *Coronilla Emerus* and *Baccharis halimifolia*. Kew Gardens." The pycnidium of *Diaporthe Coronillae*. Sacc. No fungus answering to this description could be found on the Kew specimens, although there were a *Diplodia* and a

Hendersonia, as well as other fungi. The species of Westendorp (no. 966) is a decided *Phomopsis* (Fig. 32), and the spores as usual tend to be plainly fusoid (not ovoid-oblong); the sporophores are acicular and flexuous, rather than arcuate, but of the dimensions given. Saccardo's Mycoth. Ven. no. 1210 yielded nothing but Phlyctaena-like spores, 15-16 × 1 μ, which are no doubt the B-spores of the same species.

79. **Phomopsis foveolaris,** *Trav.* l.c. p. 257. *Sphaeria foveolaris*, Fr. Syst. Myc. ii. 499. *Phoma foveolaris*, Sacc. in Mich. ii. 94.

"Spores ovoid or obovoid, 6 × 3 μ."

"On dead branches of *Euonymus*. Kew Gardens." There is every probability that this may be found in Britain, but the Kew specimens are not a *Phomopsis*. In Continental specimens the spores are seen to be less fusoid and broader in comparison with their length than is usual in that genus. It is considered to be the pycnidium of *Diaporthe Laschii*, Nits.

80. **Phomopsis morphaea,** *Grove*. *Phoma morphaea*, Sacc. in Mich. ii. 273.

"On stems and capsules of *Papaver*" *orientale* (not *somniferum*, as stated). "Kew Gardens. Jan."

The species of Saccardo is decidedly a *Phomopsis*, but nothing answering to his description can now be found on the Kew specimens, although there are some other fungi, including a *Diplodina* (*D. morphaea*, sp. n.) which might have been mistaken for it.

81. **Phomopsis Ophites,** *Trav.* l.c. p. 254. *Phoma Ophites*, Sacc. Syll. iii. 89.

Spores fusoid, acute at the ends, straight, 8-10 × 2 μ; sporophores acicular, crowded, 15 × 1·5 μ.

"On dead stems of *Hibiscus syriacus*. Kew Gardens." The pycnidium of *Diaporthe Ophites*, Sacc. French specimens agree exactly with the description; the pycnidium is immersed wholly in the wood, and is as incomplete as that of *P. Arctii*. But on the Kew specimens of Cooke there is nothing in the remotest degree resembling these.

82. **Phomopsis sambucella,** *Trav.* l.c. p. 244. *Phoma sambucella*, Sacc. Syll. iii. 71.

"On dead branches of *Sambucus nigra*. Kew Gardens." Said to be the pycnidium of *Diaporthe spiculosa*, Nits., but no specimens seen (including those of J. W. Ellis from Cheshire) agreed with the description. The latter are distinctly not a *Phomopsis*.

83. **Phomopsis sarmentella,** *Trav.* l.c. p. 277. *Phoma sarmentella*, Sacc. Syll. iii. 140.

"Spores cylindric-fusoid, curvulous, obtuse, 5-6 × 2-3 μ; sporophores rod-shaped, about twice as long as the spore."

"On Hop bines. Isleworth." Probably the pycnidium of *Diaporthe sarmenticia*, Sacc. On the specimens from this

locality, however, in Herb. Kew, no *Phomopsis* can be found, only *Phoma herbarum*, f. *Humuli*, and two fungi belonging to other genera.

84. **Phomopsis Staphyleae,** *Grove.* *Phoma Staphyleae*, Cke. in Grevill. xiv. 2.

Spores elliptic-fusoid, often acute at the lower end, 8-10 × 2·5-3 μ; sporophores rod-like, about 10 μ long.

On thin twigs of *Staphylea colchica*, *S. pinnata*, *S. trifoliata*. Kew Gardens. These specimens appear to be a *Phomopsis*, though the conclusion is not quite free from doubt. Cooke describes the sporophores as indistinct, but I find them as stated. If it is a *Phomopsis*, it is probably nothing but a smaller form of *P. Robergeana;* see no. 55.

85. **Phomopsis Tecomae,** *Grove.* *Phoma Tecomae*, Sacc. Syll. iii. 91.

"Spores fusoid, somewhat obtuse at the ends, 8 × 3 μ; sporophores filiform, curvulous, 20 × 1 μ."

"On *Tecoma radicans*. Kew Gardens." On the Kew specimens, there is nothing at all resembling the description of this species, only a large quantity of a *Coniothyrium* which agrees with other specimens of *C. Fuckelii* except that the spores are very pale in colour.

86. **Phomopsis Vepris,** *v. Höhn*, l.c. p. 33. *Phoma Vepris*, Sacc. Syll. iii. 76.

"Spores fusoid, 6 × 1·5 μ; sporophores very short."

"On *Rubus fruticosus*." This has been regarded as British on the faith of some specimens collected at Oxford (Baxter), but wrongly so. They are imperfectly developed, with hardly any spores, but do not in any case agree with *Phomopsis*.

87. **Phomopsis vicina,** *Grove.* *Phoma vicina*, Desm. Exs. ser. ii., no. 352.

"Spores oblong, somewhat curved, without guttules, 5 × 2 μ."

"On decorticated branches of *Sambucus nigra*. Ascot." Desmazières' specimens (l.c.) on *Sambucus* are a true *Phomopsis*, with subfusoid biguttulate spores 7-10 × 2-2·5 μ; sporophores cylindrical or subulate, straight or curved, 15-25 × 1·5 μ. They should be compared with the other species on *Sambucus*, with one of which they are probably identical, but in any case the Ascot specimens are excluded, as not belonging to *Phomopsis*, but probably to *Coniothyrium*.

88. **Phoma Asparagi,** Sacc. in Mich. i. 257.

This is said to be a *Phomopsis*, and American specimens seem to support the claim, but no good British specimens have yet been seen.

89. **Cytospora stictostoma,** Grove in Journ. Bot. 1916, p. 190.

This species presents certain resemblances to a *Phomopsis*, and appears to be intermediate between the two genera. Cf. no. 40.

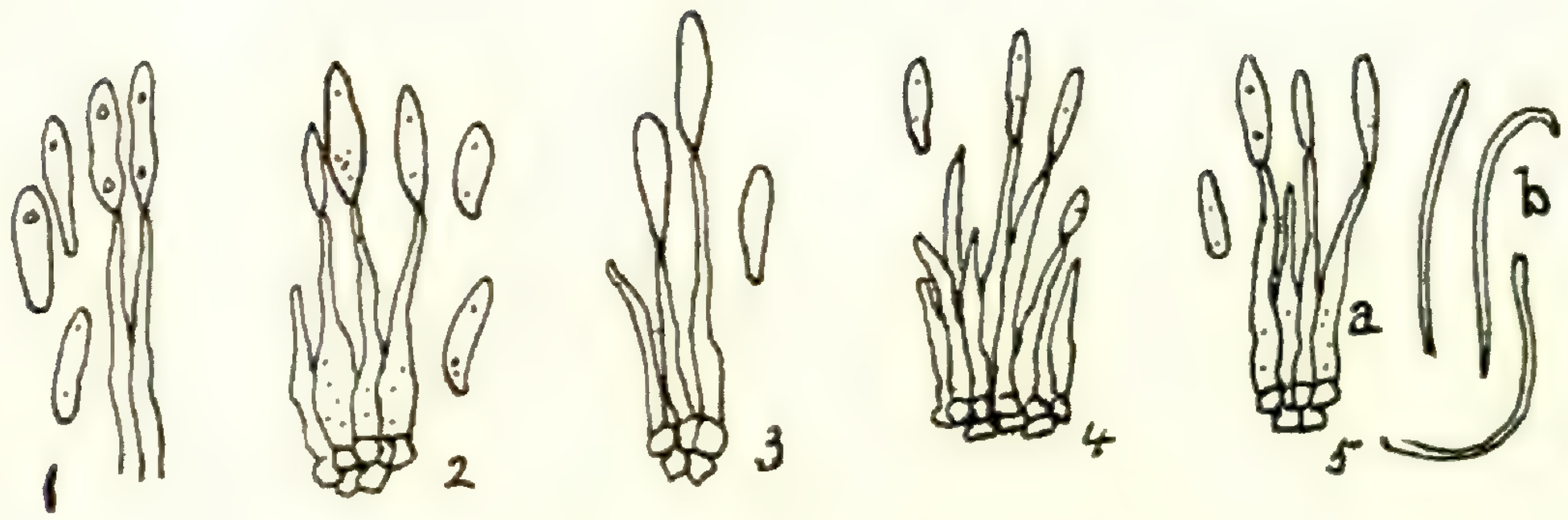
List of Host-Plants.

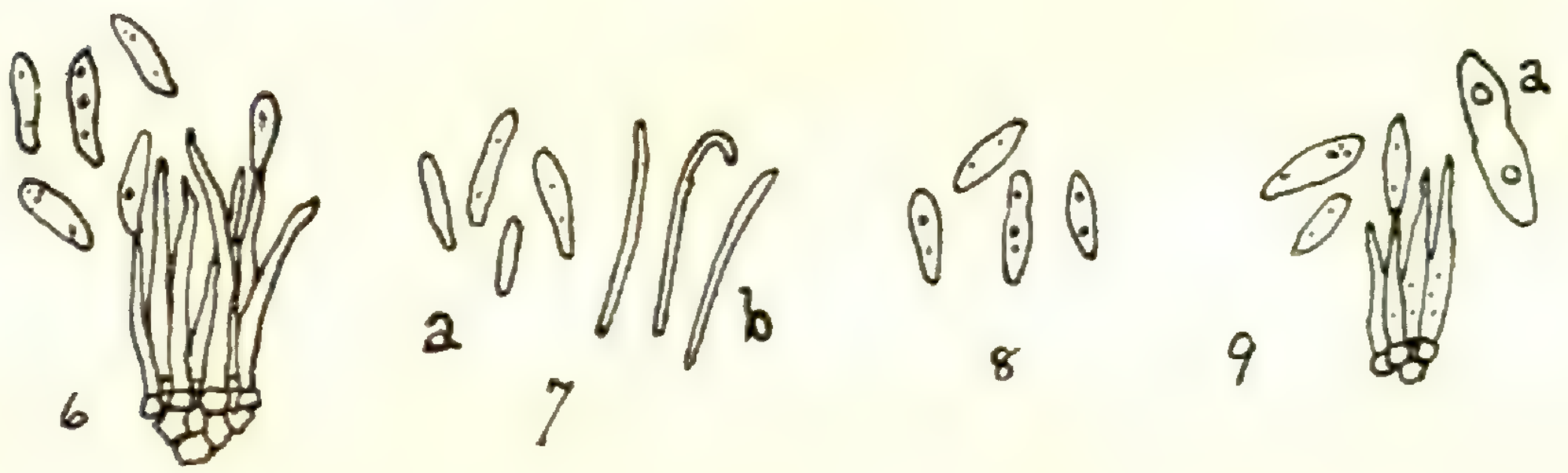
Abies, 40.
Acer, 44, 50.
Achillea, 1.
Aesculus, 16.
Amelanchier, 4.
Arctium, 5.
Aristolochia, 72.
Asparagus, 88.
Aucuba, 7, 73.
Baccharis, 78.
Buxus, 65.
Cactus, 9.
Calystegia, 10.
Chaerophyllum, 12, 66
Cistus, 15.
Cocculus, 36.
Colutea, 77.
Cornus, 17.
Coronilla, 78.
Crucifera, 75.
Cytisus, 57, 66.
Dianthus, 11.
Dipsacus, 20.
Eryngium, 74.
Euonymus, 13, 79.
Ficus, 14.
Fraxinus, 48, 62.
Hedera, 49.
Heracleum, 6.
Herminiera, 26.
Hibiscus, 81.
Humulus, 83.
Hypochoeris, 2.
Juglans, 29.
Kerria, 28, 66.
Leontodon, 2.
Lonicera, 18, 33.
Lysimachia, 34.
Maclura, 23.
Magnolia, 70.
Malva, 35.
Menispermum, 36.
Morus, 37.
Negundo, 31.
Neillia, 64.
Papaver, 88.
Phaseolus, 42.
Philadelphus, 30.
Phytolacca, 68.
Picea, 40.
Plantago, 67.
Platanus, 53.
Podophyllum, 45.
Polygonum, 46.
Prunus, 47.
Pyrus, 3.
Quercus, 25, 51, 52.
Rhamnus, 24.
Rhus, 54.
Robinia, 41.
Rosa, 27, 43, 56.
Rubus, 38, 86.
Rumex, 22.
Salix, 59.
Sambucus, 60, 66, 82, 87.
Sarothamnus, 61.
Scrophularia, 39.
Solanum, 21, 76.
Sophora, 63.
Spiraea, 64.
Staphylea, 55, 84.
Symphoricarpus, 58.
Syringa, 19.
Tamus, 68.
Tecoma, 85.
Tilia, 69.
Viburnum, 8.
Vinca, 32.
Vitis, 71.

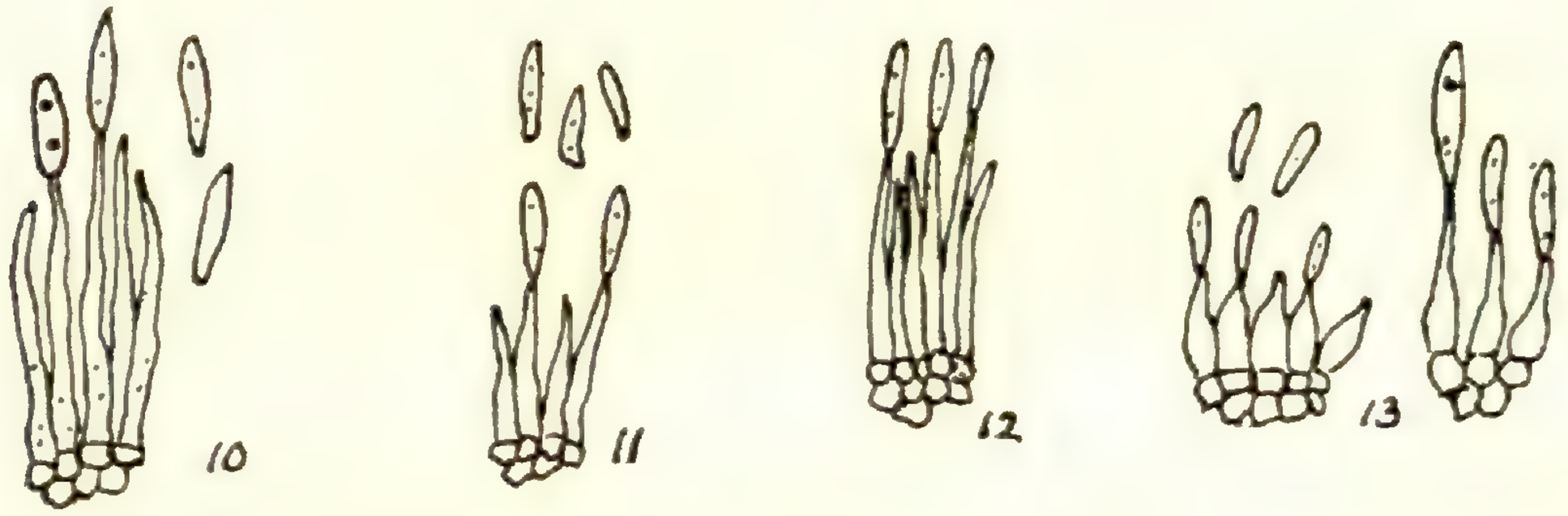
Explanation of Plates.

Fig.

1. P. Achilleae.
2. P. Albicans.
3. P. ambigua.
4. P. Amelanchieris.
5. P. Arctii; a, A-spores; b, B-spores.
6. P. Asteriscus.
7. P. Cacti.
8. P. Caryophylli.
9. P. Celastrinae; a, ? ascospore.







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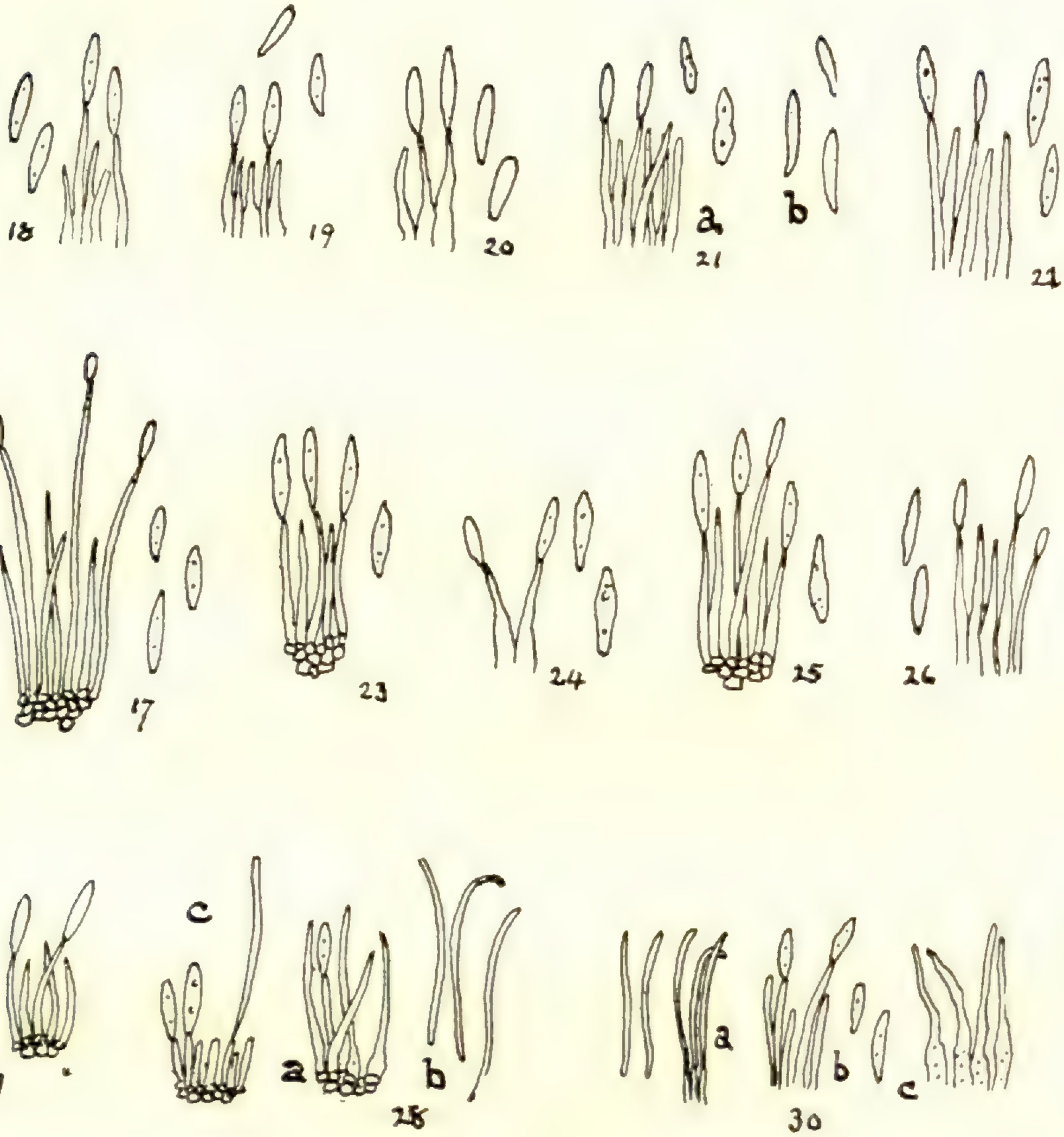
18
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c
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a
b
c
32

Fig.
10. P. cinerascens.
11. P. Corni.
12. P. Dipsaci.
13. P. glandicola.
14. P. Herminierae; a, A-spores; b, B-spores.
15. P. Landeghemiae.
16. P. Lonicerae; a, A-spores; b, B-spores.
17. P. Menispermi.
18. P. moricola.
19. P. petiolorum.
20. P. Phaseoli.
21. P. piceata; a, spores; b, spores of C. concava.
22. P. Podophylli.
23. P. pterophila.
24. P. quercella.
25. P. Radula.
26. P. sambucina.
27. P. scobina.
28. P. Sorbariae; a, A-spores; b, B-spores; c, the two, side by side.
29. P. striaeformis.
30. P. velata; a, B-spores; b, A-spores and c, elongated sporophores of *P. communis*.
31. P. aucubicola; a, B-spores; b, A-spores; c, an elongated sporophore.
32. P. Coronillae; a, A-spores; b, B-spores.

All the figures are magnified 1000 times.

VII.—ADDITIONS TO THE WILD FAUNA AND FLORA OF THE ROYAL BOTANIC GARDENS, KEW: XV.

Coccidae.

E. Ernest Green.

By the courtesy of the authorities I was permitted to search the plant houses in the Royal Botanic Gardens at Kew, for *Coccidae*, on the 7th of December last. It may be interesting to compare the result of my search with the previous occasion—twenty years ago (in May, 1896)—when I visited the Gardens with a similar object. On that occasion I listed sixteen distinct species, and Prof. Newstead, as the result of a visit in the same year, added six others, making twenty-two species in all. On the present occasion I again found sixteen species (mentioned below); but, of these, three had not previously been recorded from the Gardens (or, indeed, from the British Isles), one of the three being new to science.

On going through these splendid houses, containing countless plants from every part of the world, I had a selfish feeling of disappointment that, owing to the evident care with which the

plants had been tended and doctored, comparatively so few insects were to be found. With the exception of three or four common greenhouse pests, which it is practically impossible to eradicate from any conservatory, the species observed were the result of very diligent search, and were represented by few individuals only.

I append a list of the species taken on this occasion.

1. **Lecanium tessellatum,** *Sign.*
Commonly on various palms. Also on *Tabernaemontana* sp., *Ardisia humilis* and *Ochna pumila.*

2. **Lecanium hemisphaericum,** *Targ.*
On *Carissa* sp. and *Rheedia.*

3. **Lecanium longulum,** *Dougl.*
On *Monodora,* sp., *Treculia, Carissa,* and *Excoecaria discolor.*

4. **Lecanium oleae,** *Bern.*
On *Erythrina* sp.

5. **Lecanium nigrum,** (?) var. **depressum,** *Targ.*
Abundantly on *Musa.* More rarely on *Chrysophyllum, Malacantha,* and *Ficus* spp.

These examples have all the microscopical characters of typical *nigrum,* but have a different external fascies, being of a dull brown colour and less strongly convex than the type.

6. **Lecanium signiferum,** *Green.*
On *Polypodium aurem.*

This insect has hitherto been recorded from Ceylon and India only. It is possible that it may be—as suggested by Sanders—a varietal form of *L. hesperidum*; but, if so, its very characteristic colour pattern (green or olivaceous, with strongly-marked purplish or blackish longitudinal stripe and double transverse bands) make it deserving of a distinct name.

7. **Pulvinaria floccifera,** *Westw.*
On *Cordia* sp.

A common hot-house pest, affecting more particularly orchids of many kinds.

8. **Pseudococcus longispinus,** *Targ.*
This appears to be the most widely distributed Coccid in the Kew houses. Amongst numerous other plants I noted its occurence on *Musa, Cycas, Euphorbia,* and *Cotyledon pringlei.*

9. **Pseudococcus citri,** *Risso.*
This usually common greenhouse pest was noticed only on *Solandra* and a species of *Euphorbia.*

10. **Pseudococcus nipae,** *Mask.*
Rather commonly on various palms; more particularly on *Cocos, Kentiopsis,* and *Sabal.*

This interesting species has not previously been recorded from the British Isles. Mr. Fryer sent me examples, a few months

ago, taken on an imported palm in a London sale-room, but the insect must have been established at Kew for some considerable time, though unnoticed hitherto. It may be readily recognised by its distinct buff colour and by the compact conical waxy processes on the dorsum.

11. **Diaspis echinocacti,** *Bouche.*
On *Cereus* sp.

12. **Hemichionaspis aspidistrae,** *Sign.*
On *Polypodium aureum.*

13. **Aspidiotus ficus,** *Ashm.*
On *Pandanus.*

14. **Aspidiotus hederae,** *Vallot.*
On *Euphorbia,* sp. and *Asparagus falcatus.*

15. **Ischnaspis filiformis**, *Dougl.*
Abundant on various palms.

16. **Lepidosaphes** sp. nov. (to be described elsewhere).
On *Nephrodium* sp.

Other records of Coccidae collected at Kew are to be found in Newstead's "Monograph of British Coccidae" and, at rare intervals, in the pages of the "Entomologist's Monthly Magazine." It may be useful to bring together all these records (42 in all, exclusive of indigenous open-air species) in the following list of species that are known to have occurred in the plant houses of the Royal Botanic Gardens.

Icerya aegyptiaca.
Orthezia insignis.
Asterolecanium bambusae.
Coccus tomentosus.
Gymnococcus agavium.
Ripersia filicicola.
Pseudococcus citri, longispinus, nipae.
Vinsonia stellifera.
Pulvinaria floccifera.
Lecanium hemisphaericum, nigrum, nigrum-depressum, oleae, hesperidum, signiferum,* longulum, tessellatum* (= *perforatum*).
Pinnaspis buxi (= *pandani*).
Hemichionaspis aspidistrae.
Diaspis boisduvallii, echinocacti (= *calyptroides*), *carueli, pentagona, persimilis.**
Howardia biclavis.
Aspidiotus ficus, hederae, personatus, spinosus, dictyospermi, cyanophylli, perseae, aloes (probably wrongly determined).
Gymnaspis aechmeae.
Parlatoria pergandei-crotonis.
Fiorinia kewensis.

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* (Additions to the list published in the "Wild Fauna and Flora of the R.B.G., Kew") of the Royal Botanic Gardens, Kew, *Kew Bull.* Add. Series V., 1906, and Additions thereto in *K.B.*, 1907, p. 97, and *K.B.*, 1908, p, 124.

Poliaspis cycadis.
Lepidosaphes pinnaeformis, and sp. nov
Ischnaspis filiformis.

VIII.—TREE LABELS AT KEW.

A very noticeable tendency in horticulture previous to the outbreak of war was the growing interest that was being taken in hardy trees. This was evident not only amongst landed proprietors and owners of gardens generally, but equally so in regard to the general public. The ordinary system of labelling the trees at Kew has been to give the botanical name, the popular or English name (if such existed), and the country of which the tree was a native. For those who had access to text-books, this information provided the key to any further knowledge they might desire to obtain about any particular tree or trees. But by far the greater proportion of visitors to Kew do not possess books on trees, and, in view of the growing popular interest in the subject, it seemed desirable to provide a label which, attached to the tree itself, would give a brief and untechnical account of its origin, its history, its economic qualities, and so on.

About eight years ago a commencement was made by printing on cards, 6 in. by 4 in., an account, running to about one hundred words, of the commoner trees. The cards were of green Willesden paper, thin, very hard, and resistant but not impervious to moisture. They were fitted in tin frames painted black with a sheet of glass in front, and the whole nailed to the tree trunks. These card labels thus protected proved to be very satisfactory, and have been much appreciated by the public. In recent years, however, it has been found difficult to keep them in order, on account of the wanton smashing of the glass fronts by mischievous visitors. In number such visitors certainly are very few, and probably young and irresponsible, but unfortunately it is easy for a single person so disposed to break a large number of these glasses. For this reason an unbreakable waterproof covering for the labels was suggested, and a method of treating them was found which has proved satisfactory and is now being generally used.

As these descriptive card-labels have been copied in other public gardens, it has been thought desirable that the following account of their treatment should be published:—

Card-Labels and Celluloid-Varnish.

The use of celluloid-varnish as a protective covering on printed card-labels was recommended by Professor C. V. Boys, F.R.S., the object in view being to make the labels resistant to damp, and therefore capable of being exposed to the weather without the protection of a facing of glass.

As an experiment, a considerable number of labels coated with celluloid-varnish have been put into use during the past twelve months, the labels being placed in the same frame-like metal holders as before, but without glass. The outcome of the experiment shows that satisfactory results can be obtained by the use of celluloid varnish made and applied as follows:—

The varnish is made by dissolving celluloid in amyl acetate so as to produce a liquid of about the consistency of thick treacle. The varnish is painted over the front and back of the labels, and is also applied to the edges, a second coat being given after the labels have been allowed to dry. To get a uniform coat, it was found best to let the card lie flat during drying, and consequently only one surface was treated at a time. A third coat of varnish is perhaps usually necessary, but the number of applications required depends on the density of the varnish, the heaviness of painting on, and probably also on the sizing of the card. After the application of two coats, one of the cards should therefore be roughly tested by allowing a pool of water to lie on the face of it for some hours. Strong warping of the card would then indicate that more varnish is required.

In preparing the varnish two forms of celluloid were tried. One of these was obtained under the name of "partially digested celluloid," or "celluloid mass," and was gelatinous in appearance. The results following the use of this substance were not, on the whole, satisfactory; there is therefore no need to refer to it further.

The other material employed was waste celluloid, being, in one case, cuttings from sheet-celluloid, and, in the other, lengths of celluloid ribbon belonging to cinematograph films. To obtain the solution, pieces of celluloid are cut into narrow strips, which are then placed in amyl acetate sufficient in quantity to cover them. The mixture is kept in a closed vessel, and stirred up at intervals of one or two hours. When solution is complete, more celluloid or more solvent is added, as required, and the mixture stirred as before. This is repeated until the right consistency has been reached, the process requiring perhaps three or four days before a suitable strength can be given to the solution. The proportions may be given roughly as one ounce of celluloid to two and a half pounds of amyl acetate.

Labels should be varnished and dried in a well-ventilated place, so as to avoid an accumulation of the vapour of amyl acetate.

IX.—THE STRAWBERRY-RASPBERRY.

(*Rubus illecebrosus*, Focke.)

R. A. Rolfe.

For a good many years a dwarf herbaceous Rubus has been in cultivation under the name of the Strawberry-Raspberry. As a drawing has been made for the "Botanical Magazine," and its history has been much confused, the opportunity is taken of clearing the matter up, so far as materials are available.

In an account of the Rubi of Eastern Asia, published in 1871, Maximowicz included under "*R. rosifolius β coronarius*" (1) a state "*flore simplici*" and (2) a state "*flore pleno*." Of the former he says that two indigenous forms occur in Japan, an alpine one, which has dwarf annual simple stems, one or two large terminal flowers, and scarlet fruits an inch long. This is the strawberry-raspberry now under discussion, as proved by

a fruiting specimen in the Herbarium collected and named by Maximowicz himself. The locality given is "Nippon: in declivio continentali vulcani Fudzi-yama, in sylvis; November, 1892." The second form described by Maximowicz "loci magis demissis calidioribus orta," as having branched biennial stems and yellow fruits, is quite different, and may be the *R. pungens*, Camb. (Phonzo Zoufou, xxxi. fol. 14, recto), a true *Idaeobatus*, and also a native of the island of Nippon. The double state (2) is the one figured in the "Botanical Magazine" (t. 1783) as *R. rosaefolius* β *coronarius*, Sims. This Maximowicz regards as a "lusus" of the single form (1), and he states of it that it is everywhere cultivated in Japanese gardens, and may possibly mature fruit, as perfect reproductive organs are frequently present. It is on the strength of the two single forms mentioned that he adds in the diagnosis of this variety β *coronarius* "fructo rubro vel luteo succulento." Maximowicz also cites *Rubus chinensis*, Ser., as a doubtful synonym, but this proves different, as will be seen presently.

Some four years later, Franchet and Savatier enumerated the Strawberry-Raspberry as "*Rubus rosifolius* β *coronarius*," adding the Japanese native name "Buru itsigo (Tanaka)," and citing a figure of a flowering specimen in the Japanese work, "Phonzo Zoufou," vol. xxv. fol. 15, recto, "sub Tokouri itsigo," and a specimen collected by Savatier on Mt. Fuji-yama in this state is preserved at Kew.

In 1898 what is clearly the alpine dwarf form of Maximowicz was figured in the "Wiener Illustrirte Garten-Zeitung" as the Japanese Erdbeer-Himbeere, and it is said to have been introduced to cultivation two years previously. In the following year a note was contributed to the "Gardeners' Chronicle" by Mr. C. Wolley Dod to the effect that in the previous autumn he received a small plant from a lady, who got it from France under the name of "Fraisier-Framboisier," and it was said to be a hybrid between a strawberry and a raspberry. The plant appeared so unlike both reputed parents that Mr. Wolley Dod had sent it to be named, and was told "on good authority" that it was *Rubus rosaefolius*, Smith, a native of Tropical Asia. This determination seems to have been an echo of the original error of Maximowicz.

In 1899 Focke, unaware of its identity with Maximowicz's alpine dwarf form (1) described the same plant as a new Rubus, of which he had received flowering and fruiting specimens from Inspector Rettig, of Jena, adding that this was the *R. sorbifolius* of gardens, but not of Maximowicz. The name "*illecebrosus*" was given in allusion to the attractive fruit, and the plant as to habit was compared with *R. xanthocarpus*, Bur. & Franch. Its native country was stated to be probably Japan. In his later Monograph, Focke placed the plant in the section *Idaeobatus* just before *R. rosaefolius*, Smith, and he compared it with *R. fraxinifolius*, Poir., but this is not its proper position, for the drupeoles when mature do not part freely from the persistent receptacle, as in the Raspberry set, but are firmly attached to it, both breaking away together. In fact it belongs to the section *Cylactis*, and to

the small sub-section *Xanthocarpi*, of which *R. xanthocarpus*, Bur. & Franch., is the type. There is an imperfectly described *Cylactis*, also from the island of Nippon, viz., *Rubus minusculus*, Lév. & Van., which was said to differ from *R. pedatus*, Smith, in the non-creeping stem, pinnate leaves with lanceolate sessile incise-denticulate leaflets, somewhat resembling those of a *Sorbus*, and hairy sepals. It was based on a plant collected by Faurie (n. 3187), but unfortunately no specimen is available for comparison. The characters are so much in agreement with *R. illecebrosus* as to suggest that it may be a form of the same species.

The establishment of the synonymy of this plant involved the identity of *Rubus chinensis*, Ser., which Maximowicz doubtfully included under his *var. coronarius flore simplici*. As no specimen was available for comparison, application was made to Dr. C. de Candolle, who has kindly forwarded a life-sized photograph of the original specimen in the Candollean Herbarium, together with fragments of the foliage. The specimen is young, with partially-developed buds, and is clearly an *Idaeobatus*, which matches best *R. Thunbergianus*, Sieb. & Zucc., in fact, the details of shape, venation and texture are quite in agreement. It agrees neither with *R. rosaefolius* nor with *R. illecebrosus*.

R. rosaefolius, Smith (Bot. Mag. t. 6970), is a tropical plant which is not hardy in England, and apart from the different habit and sectional characters above pointed out, it is also readily distinguished by floral characters.

The following is the synonymy of *R. illecebrosus*:—

Rubus illecebrosus, *Focke* in Abh. Nat. Ver. Bremen, xvi. p. 278 (1899), et in Bibl. Bot., Heft 72, p. 152, fig. 64; Rettig in Die Gartenwelt, iv. p. 233, with fig.; Späth Cat. 1912-13, n. 154, p. 123; Kew Bull. App. 3, p. 74 (1913); Amer. Gard. xxiv. p. 603; Bailey Stand. Cycl. Hort. v. p. 3029, fig. 3497, 3498.

R. rosifolius β *coronarius flore simplici forma altera* (alpina), Maxim. Mél. Bot. viii. p. 388 (1871) et in Bull. Acad. Imp. St. Petersb. xvii. p. 157.

R. sorbifolius, Hort. ex Focke in Abh. Nat. Ver. Bremen, xvi. p. 278 (non Maxim.).

R. rosifolius β *coronarius*, Franch. et Sav. Enum. Pl. Jap. i. p. 126, in part (non Smith).

R. rosaefolius γ *coronarius a simpliciflora*, Makino in Tokyo Bot. Mag. xv. p. 52 (1901); Matsum. Ind. Pl. Jap. p. 236 (in part).

R. rosaefolius, Wolley Dod in Gard. Chron. 1899, xxvi. p. 240; J. H. Wilson in Journ. Hort. Soc. Genet. pp. 207, 208, fig. 49 B.* (non Smith).

Erdbeer-Himbeere, Wien. Ill. Gart. Zeit. 1898, pp. 75, 77, fig. 22.

Strawberry-Raspberry, Gard. Chron. 1898, xxiii. p. 139; 1909, xlvi. p. 403; Garden, 1903, lxiv. pp. 275, 353, 411, 412, with fig.

Icon. Jap. Phonzo Zoufou, xxv. fol. 15, recto.

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* The parentage of the hybrid described and figured here by Wilson (fig. C) now requires to be amended to *R. occidentalis* × *illecebrosus*.—R. A. R.

X.—NEW ORCHIDS: DECADE XLV.

441. **Pleurothallis** (§ **Apodae caespitosae**) **costaricensis,** *Rolfe;* affinis *P. longissimae,* Lindl.; sed foliis minoribus, sepalis lateralibus connatis apice minute denticulatis differt.

Herba epiphytica, caespitosa; caules secundarii nulli. *Folia* breviter petiolata, anguste oblanceolato-oblonga, subobtusa, coriacea, 4–5 cm. longa, 0·5–0·6 cm. lata, basi attenuata. *Scapi* elongati, 12–15 cm. longi, basi vaginis spathaceis brevibus paucis obtecti; racemi 7–10 cm. longi, multiflori. *Bracteae* ovatae, acutae, circiter 1·5 mm. longae. *Pedicelli* graciles, 3 mm. longi. *Sepala* conniventia, circiter 0·9 cm. longa; posticum lanceolatum, acuminatum; lateralia connata, lanceolata, acuminata, apice minute bidentata. *Petala* linearia, subacuta, 2 mm. longa. *Labellum* pandurato-oblongum, obtusum, 2 mm. longum. *Columna* oblonga, marginata, 2 mm. longa.

Central America. Costa Rica, near Cachi, *C. H. Lankester* 21.

Sent to Kew by Mr. C. H. Lankester, in 1915, and flowered in the collection in May, 1916. The flowers are light greenish yellow, with rather darker nerves and lip.

442. **Cirrhopetalum longidens,** *Rolfe;* habitu *C. picturato,* Lodd., subsimile, sed sepalo postico non setifero et columnae dentibus multo longioribus et medio oblique auriculatis facile distinguendum.

Herba epiphytica. *Rhizoma* validum, repens. *Pseudobulbi* subapproximati, ovoidei, 1·5–2 cm. longi, monophylli, basi vaginis membranaceis obtecti. *Folia* elliptico-oblonga, obtusa, 5–11 cm. longa, 2·5–3 cm. lata, coriacea, basi attenuata. *Scapi* deflexi, graciles, circiter 18 cm. longi, pauciflori, vaginis spathaceis paucis obtecti. *Bracteae* ovato-lanceolatae, acuminatae, 0·6–0·8 cm. longae. *Pedicelli* circiter 2 cm. longi. *Flores* mediocres. *Sepalum* posticum elliptico-oblongum, subapiculatum, minute denticulatum, concavum, 1·3 cm. longum; sepala lateralia connata, elongato-oblonga, subobtusa, 2–2·5 cm. longa. *Petala* elliptico-oblonga, subobtusa, spinuloso-ciliata, 0·8 cm. longa, facie papillosa. *Labellum* recurvum, carnosum, deltoideo-oblongum, subobtusum, 0·8 cm. longum. *Columna* lata, 3–4 mm. longa; dentes falcati, 0·5 cm. longi, medio oblique auriculati, apice graciliter subulati.

Habitat unknown.

Flowered in July, 1916, in the Kew collection, where it has been for a considerable time as a small plant, but its origin cannot be traced. The flowers are yellow, with red-brown markings on the petals, dorsal sepal and base of the lateral sepals, while the lip is darker yellow. The species is remarkable for the length and shape of the teeth of the column.

443. **Eria** (**Cylindrolobus**) **albolutea,** *Rolfe;* ab E. brachystachi Reichb. f., foliis latioribus, floribus minoribus et labelli lobo intermedio cum carina pulvereo-puberulo differt.

Herba epiphytica. *Pseudobulbi* cylindrici, elongati, 25–30 cm. longi, 0·8 cm. lati, foliacei. *Folia* disticha, lanceolata vel linearilanceolata, breviter et oblique bidentata, subcoriacea, 6–10 cm. longa, 0·9–1·2 cm. lata. *Scapi* axillares, breves, uniflori, 4–5-bracteati. *Bracteae* petaloideae, lineari-oblongae, subacutae, 1–1·5 cm. longae, pallide luteae. *Pedicelli* 1 cm. longi, glabri. *Sepalum* posticum lineari-oblongum, obtusum, subundulatum, concavum, 1·3 cm. longum; sepala lateralia ovato-oblonga, obtusa, subundulata, concava, 1–1·2 cm. longa, basi mentum obtusum 4 mm. longum formantia. *Petala* subfalcata, lineari-oblonga, obtusa, subulata, concava, 1 cm. longa. *Labellum* trilobum, 0·7–0·8 cm. longum; lobi laterales suborbiculares, obtusi, 2 mm. longi; lobus intermedius ovatus, obtusus, pulvereo-puberulus, 3 mm. longus; discus prominenter carinatus, pulvereo-puberulus. *Columna* clavata, marginata, 4–5 mm. longa.

Philippines.

Flowered in the Royal Botanic Gardens, Glasnevin, in August, 1916. The flowers are pure white, with the petaloid bracts light yellow.

444. **Epidendrum** (**Amphiglottium**) **tricarinatum,** *Rolfe;* habitu et floribus *E. evecto,* Hook. f., subsimile, sed labelli disco tricarinato facile distinguendum.

Caules erecti, elongati, teretes, 0·75–1 m. alti, inferne distichophylli, superne vaginis tubulosis imbricatis obtecti. *Folia* sessilia, oblonga vel lanceolato-oblonga, subobtusa, crassocoriacea, 4–9 cm. longa, 1·3–1·8 cm. lata. *Flores* breviter racemosi, multiflori. *Bracteae* lineari-lanceolatae, acutae, 0·5–1·5 cm. longae. *Pedicelli* 2–2·5 cm. longi. *Sepala* elliptico-oblonga, subacuta, 1–5 cm. longa. *Petala* elliptico-lanceolata, subacuta, 1·4 cm. longa. *Labellum* columnae omnino adnatum, trilobum; lobi laterales oblique cuneati, 5–6 mm. longi, apice fimbriati; lobus intermedius obcordato-bilobus, 0·9 cm. longus, apice fimbriatus; discus prominenter tricallosus; calli laterales denticulati; callus intermedius integer. *Columna* 0·5–0·6 cm. longa.

Peru. *L. Forget.*

Introduced by Messrs. Sander and Sons, St. Albans, and flowered at the Royal Botanic Gardens, Glasnevin, in June, 1916, when it was sent for determination by Sir Frederick W. Moore. Though bearing a general resemblance to *E. evectum,* Hook. f. (Bot. Mag. t. 5902), it is readily distinguished from its allies, in having the crest of the lip arranged in three thickened keels, the median one extending nearly to the division of the front lobe, and the lateral pair being shorter and crenulate. The flowers are bright purple, and the keels whitish at first, but afterwards suffused with purple.

445. **Eulophia triloba,** *Rolfe;* habitu *E. purpurascenti, Rolfe,* similis, sed labello profunde trilobo et lobis longioribus differt.

Folia 3–4, fasciculata, elongato-linearia, acuta vel acuminata, 20–30 cm. longa, 4–6 mm. lata. *Scapi* erecti, 40–45 cm. longi, subgraciles, vaginis lanceolatis obtecti; racemi 4–6 cm. longi;

laxi, pauciflori. *Bracteae* ovato-lanceolatae, acuminatissimae, 8–13 mm. longae. *Pedicelli* graciles, circiter 1 cm. longi. *Sepala* subconniventia, lanceolato-linearia, acuta, 2 cm. longa. *Petala* elliptico-oblonga, apiculata vel acuta, 2 cm. longa, 6–7 mm. lata. *Labellum* trilobum, 1·7–2 cm. longum; lobi laterales triangulari-oblongi, subobtusi, subdivergentes, 6 mm. longi; lobus intermedius obovato-oblongus, apiculatus, 1 cm. longus, dense papillose-cristatus; discus basi 3-carinatus; calcar clavato-oblongum, obtusum, 7 mm. longum. *Columna* clavata, 8 mm. longa.

South Africa. Natal; Ginginhlova, 0–70 m., *Haygarth, in Herb. Wood* 11785.

446. **Eulophia elegantula,** *Rolfe;* affinis *E. ovatipetalae,* Rolfe; sed humilior, petalis angustioribus et labelli calcare breviore facile distinguenda.

Folia fasciculata, linearia, acuminata (immatura). *Scapi* 25–40 cm. alti, vaginis paucis spathaceis obtectis; racemi 4–8 cm. longi, laxiflori. *Bracteae* ovatae vel ovato-lanceolatae, acuminatae, 6–12 mm. longae. *Pedicelli* subgraciles, 1·5 2 cm. longi. *Sepala* lanceolato-oblonga, subacuta, 1·5 cm. longa. *Petala* elliptico-oblonga, obtusa, 1·3 cm. longa. *Labellum* 3-lobum, 1·2 cm. longum; lobi laterales suborbiculari-oblongi, obtusi, breves; lobus intermedius obovato-oblongus, obtusus, convexus, carinatus, 7–8 mm. longus; discus striatus et obscure verrucosus; calcar conicum, subobtusum, strictum, 5–6 mm. longum. *Columna* clavata, 8 mm. longa.

South Africa. Natal; Gillitts, 650 m., *J. Medley Wood* 11789.

A dwarf species, bearing a tuft of short, straight leaves at flowering time. The flowers are described as brown and yellow.

447. **Eulophia obcordata,** *Rolfe; E. hyanti,* Spreng., similis, sed labello crassiusculo, disco 5-7 carinato et tuberculis crassiusculis differt.

Folia fasciculata, linearia, acuminata (immatura). *Scapus* erectus, circiter 30 cm. altus, vaginis paucis spathaceis obtectis; racemus circiter 7 cm. longus, laxiflorus. *Bracteae* elliptico-lanceolatae, acutae, 8–12 mm. longae. *Pedicelli* graciles, 1–1·5 cm. longi. *Sepala* oblonga, apiculata, 1·2 cm. longa. *Petala* elliptico-oblonga, apiculata, 1·2 cm. longa. *Labellum* 3-lobum, 1·2 cm. longum; lobi laterales breves, triangulari-oblongi, subacuti, divergentes, 2–3 mm. longi; lobus intermedius late obcordato-oblongus, 6–7 cm. latus, subundulatus; discus 5–7-carinatus, carinis tuberculis crassiusculis instructis; calcar filiforme, obtusum, incurvum, circiter 6 mm. longum. *Columna* clavata, 6 mm. longa.

South Africa. Natal; Gillitts, 700 m., *J. Medley Wood* 11789a.

Near *E. hians,* Spreng., but the differently shaped bracts and lip, with more numerous keels and thicker texture, serve to distinguish it. It was found mixed with the preceding species.

448. **Eulopia durbanensis,** *Rolfe;* affinis, *E. papillosae,* Schlecht., sed floribus crassiusculis et labelli lobis lateralibus minoribus differt.

Folia 3–4, fasciculata, elongato-linearia, acuta vel acuminata, striata, 30–40 cm. longa, 4–7 mm. lata. *Scapi* erecti, 45–55 cm. alti, vaginis elongatis acuminatis imbricatis obtecti; racemi 6–9 cm. longi, sublaxi, multiflori. *Bracteae* lineari-lanceolatae, acuminatissimae, 1–1·2 cm. longae. *Pedicelli* graciles, 1–1·5 cm. longi. *Sepala* ovato-oblonga, subobtusa vel apiculata, circiter 1 cm. longa. *Petala* elliptico-ovata, obtusa vel apiculata, 9 mm. longa. *Labellum* late obovato-oblongum, 1 cm. longum; lobi laterales oblique ovati, obtusi, 3 mm. longi; lobus intermedius obovatus, retusus, 5–6 mm. longus; discus papillis brevibus numerosis instructus, prope basin bicarinatus, carinis brevibus elevatis. *Columna* clavata, 6 mm. longa.

South Africa. Natal; near Durban, 0–90 m. *J. Medley Wood* 11775.

449. **Maxillaria Shepheardii,** *Rolfe;* affinis *M. Parkeri,* Hook., sed sepalis multo angustioribus et petalis immaculatis facile distinguenda.

Herba epiphytica. *Pseudobulbi* aggregati, late ovoidei vel interdum obovoidei, depressi vel subtruncati, 1·5–2 cm. longi, monophylli, basi vaginis membranaceis obtecti. *Folia* petiolata, elliptico-oblonga, subobtusa, coriacea, 10-23 cm. longa, 3·5-6 cm. lata; petioli conduplicati, 2–5 cm. longi. *Flores* numerosi, erecti; pedicelli 4·5–6 cm. longi, vaginis tubuloso-spathaceis subimbricatis obtecti. *Bracteae* spathaceae, lanceolato-oblongae, subacutae, circiter 1·5 cm. longae. *Sepala* subpatentia, anguste lanceolato-oblonga, subobtusa, 2–2·3 cm. longa, lateralia in mentum brevem obtusum extensa. *Petala* lineari-oblonga, subobtusa, 1·8 cm. longa. *Labellum* 1·2 cm. longum, trilobum; lobi laterales anguste oblongi, obtusi vel subtruncati; lobus intermedius ellintico-ovatus, obtusus, crassiusculus, 4 cm. longus; callus lineari-oblongus, obtusus, prope apicem incrassatus. *Columna* clavato-oblonga, 8 cm. longa; alis denticulatis.

Colombia. Rio Condoto, Chcco District, *Dr. S. Shepheard.*

Acquired for Kew in 1914, from Mrs. Shepheard, Abbotts Hall, Aylsham, and flowered in the collection in July, 1916. The flowers are produced in profusion from beneath the pseudobulbs, and have rather short pedicels. The sepals are deep yellow, somewhat suffused with brownish-red towards the apex, the petals yellowish white, and the lip yellow, striped with light red on the disc and side lobes, with the apex of the crest orange-red.

450. **Dichaea ciliolata,** *Rolfe;* affinis *D. hystricinae,* Reichb. f., sed foliis latioribus et fere duplo brevioribus differt.

Herba epiphytica, erecta, nana, ramosa. *Caulis* subcompressus, distichophyllus, pallide viridis. *Folia* sessilia, patentia, ovata vel anguste ovata, mucronata, ciliolata, 0·3–0·4 cm. longa, apice recurva, basi amplexicaulia. *Flores* axillares; pedunculi graciles, 0·8 cm. longi, uniflori. *Bracteae* late ovatae, apiculatae,

membranaceae, 1 mm. longae. Ovarium breve, longe hirsutum, pilis crassiusculis et patentibus. *Sepala* subpatentia et paullo incurva, lanceolato-oblonga, subacuta, 0·7–0·8 cm. longa. *Petala* subpatentia, elliptico-lanceolata, subacuta, 0·7–0·8 cm. longa. *Labellum* breviter unguiculatum, subincurvum, hastato-trilobum, prope basin angulatum, 0·7 cm. longum; lobi laterales falcato-oblongi, incurvi, 3 mm. longi; lobus intermedius ovatus, subobtusus, apice paullo recurvus. *Columna* clavato-oblonga, 0·5 cm. longa, rostellum oblongum, pubescens, violaceum.

CENTRAL AMERICA. Costa Rica, near Cachi, *C. H. Lankester* 12.

Sent to Kew by Mr. C. H. Lankester in 1915, and flowered in the collection in July, 1916. The flowers are pale buff with red-purple spots and bars, the lip white with purple spots and a similar suffusion on the side lobes, the column pale buff margined with dull purple, and the rostellum violet.

XI.—MISCELLANEOUS NOTES.

We note with pleasure in the recently issued list of New Year Honours the names of DR. FRANCIS WATTS, Imperial Commissioner of Agriculture for the West Indies, and DR. LEONARD RODWAY, Government Botanist, Tasmania, both of whom His Majesty has been graciously pleased to appoint to be Knights Commander of the Most Distinguished Order of St. Michael and St. George.

GEORGE EDWARD MASSEE.—Rather less than two years ago it was our pleasant task to give, in the pages of the *Kew Bulletin*, a notice of the life and work of Mr. G. Massee on the occasion of his retirement. We have now the sad duty of recording his death, which occurred after a short illness at Sevenoaks on February 17th, 1917.

After his retirement on March 31st, 1915, Mr. Massee removed to Park Place, Sevenoaks, where he busied himself with gardening and other pursuits. He also investigated the mycology of the district, and had suggested the holding of a fungus foray in that neighbourhood in the autumn of the present year.

George Massee was a Yorkshire man, being born at Scampston about the year 1850. For a general account of his life, his scientific work, and his skill as an artist, the former article (*K.B.* 1915, pp. 118-120), must be consulted. A few additional lines as to his career may, however, be added since Mr. Massee was not only one of the great men of Kew, but was known the world over as an authority on fungi.

His earlier work on fungi was almost entirely from the morphological and systematic standpoint, his later work and that by which he is most widely known in this country, was largely on plant diseases. But if the latter subject attracted him and appealed most to the general public, his systematic work was on the whole the more important and will find a more permanent place in the history of mycology.

Massee formed an interesting link between the older generation of mycologists, typified by the great master Fries of Sweden, and Berkeley, Cooke and Worthington G. Smith in England (the last-named of whom is happily still living), who relied largely on external morphology, and the modern school to whom the advantages of a training in refined microscopic technique and methods of pure culture have meant so much. In his older systematic works Massee broke new ground and fearlessly adopted microscopic characters as the distinctive features of certain difficult genera. In his pathological work he soon appreciated the value of pure culture and detailed microscopic examination, and adapted himself considerably in investigation along those lines. The advances made in methods of culture and inoculation have been so great and varied during the last ten, or even five, years, that in judging his work, allowance for this fact should always be made.

Massee was always a man of energy and enthusiasm. He was largely instrumental in founding the British Mycological Society, and became its first President. In later years he was a regular attendant of the Fungus Foray of the Yorkshire Naturalists' Union, and was for many years President of the extremely active Mycological Committee of that Society, Charles Crossland, his pupil of former days, whose death was recently noted in the *Bulletin*, being the Secretary. To beginners who showed genuine interest, Massee gave ready help and advice. The writer first visited him at the Herbarium in 1901 with a collection of fungi from the old Royal Horticultural Society's garden at Chiswick. Massee was enthusiastic and inspiring, the collection was promptly named, and the invitation given to come again. That was the first of many visits, and the writer is glad to have this opportunity of acknowledging his indebtedness to the help and kindness received from that day onward. Massee was a remarkable personality. Though quick and shrewd, and often very outspoken, he was kindhearted. His sense of humour and breezy sayings were fully appreciated in the Herbarium, and his presence was greatly missed on his retirement.

On giving up his official duties, Massee resigned his Fellowship of the Linnean Society, but had the honour of being elected an Associate the following year. The most important of his works are mentioned in the article already referred to, a full list of his publications, as far as can be ascertained, has been prepared and will, it is hoped, be published at some later date.

A. D. C.

The late Prof. H. H. W. Pearson.—In the List of Publications by the late Prof. H. H. W. Pearson given in *K.B.*, 1916, p. 279, the reference Trans. Linn. Soc. ser. 2, viii. 311-332, tt. 31-32, should be added to the last paper in the List (Notes on the Morphology of Certain Structures concerned in Reproduction in the Genus *Gnetum*).

The Ross Orchid Drawings.—Through the kindness of the Bentham Trustees, Kew has acquired a valuable collection of Orchid paintings in water colour, made by Mrs. Janet Ross,

widow of the late H. J. Ross, Esq., Poggio Gherardo, Florence, Italy, formerly of Castagnolo, between Pisa and Florence. Mr. Ross, who was an ardent collector of Orchids, was for many years a correspondent of Prof. H. G. Reichenbach, of Hamburg, and as many of the drawings were made by Mrs. Ross from materials authenticated by the latter, they possess a historical value in addition to their artistic merit. They also correspond in a good many cases with materials preserved at Kew, for after Reichenbach's death, in 1889, Mr. Ross sent much valuable material to Kew. The drawings are about 750 in number, and are very faithfully executed. They represent for the most part such species as can be grown in the climate of Florence, and include a good many from Upper Burma, which were brought home by a friend from Mandalay, and formed the nucleus of the collection. Others were subsequently added, until the collection became one of the finest in Italy, numbering nearly one thousand species. Florence is too hot in summer for the cooler-growing species of the American Cordilleras, though some of them are represented in the collection, drawn from plants introduced by Mr. Ross, which generally flowered once and then rapidly deteriorated and died.

Among drawings of the original type-specimens in the collection may be mentioned *Coelogyne Rossiana*, Reichb. f., a Burmese species that flowered in the collection in 1884; *Paphinia cristata* var. *Modigliani*, Reichb. f. (*Lindenia*, t. 117), an albino of a highly-coloured species; *Dendrobium strebloceras* var. *Rossianum* (*Lindenia*, t. 124), another albino; *Peristeria Rossiana*, Reichb. f., a species of doubtful origin that flowered in 1889; *Cycnoches Rossianum*, Rolfe, a Central American species which produced a raceme of male flowers in 1889, and shortly afterwards, the large solitary female flower on the same plant; and *Lycaste Rossiana*, Rolfe, another Central American plant. Probably the most interesting drawing in the collection is one of *Cycnoches Warscewiczii*, Reichb. f., representing an inflorescence with five female flowers at the base, and over a dozen of the much smaller and very different males above. The actual specimen was sent to Kew by Mr. Ross and is preserved in the Herbarium. Its history is given in the "Orchid Review," vol iii. p. 263. There are also paintings of four very diverse forms of *Lycaste Janetae*, a hybrid between the orange-yellow *L. Rossiana* and the rose-coloured *L. Skinneri*, Lindl., showing an amount of segregation of character that is very rarely seen among primary hybrids. Another series shows a remarkable case of hybrid sporting in the dark purple-brown *Cypripedium Dauthieri*, a hybrid between *C. barbatum* and *C. villosum*. This first produced a sport irregularly striped and banded with purple-brown and green, which Reichenbach called var. *Rossianum*, and another harlequin-coloured sport, half greenish-yellow and half chestnut that was called var. 'Janet Ross', while still later a greenish-yellow form appeared which was called var. 'Poggio Gherardo', a change that may be roughly compared with an elimination of the purple colour of *C. barbatum*, leaving the colour of *C. villosum*, but retaining the hybrid character in other

respects. The collection forms a valuable accession to the Herbarium.

It may be added that an account of the early life of Mr. Ross is given in a work entitled "Letters from the East," by Henry James Ross, 1837 to 1857, and a Biographical notice in "Orchid Review," vol. x. pp. 282-284, while an account of the collection as it was preserved by Mrs. Ross is given in "Orchid Review," vol. xix. pp. 202-205, and of the garden generally in the "Gardeners' Chronicle" for 1912 (May 11th, p. 345).

R. A. R.

Mycological Collection of Dr. J. W. Ellis.—About three years ago the Herbarium at Kew was enriched by the acquisition of the collection of specimens and drawings of fungi made by the late Mr. C. Crossland. This British collection has now received a further valuable addition in the mycological collection of the late Dr. J. W. Ellis, which has been acquired by purchase. The collection comprises nearly 1600 dried specimens, representative of all groups of fungi. It is especially rich, however, in micro-fungi, in which Dr. Ellis was keenly interested, and includes a series of well-mounted specimens of those of economic importance. There are in addition 330 microscopic slides, which form a welcome addition to the Kew collections.

Olearia dentata and O. tomentosa.—In the Flora Australiensis, vol. iii. p. 472, these two species were regarded by Bentham as being identical. They are, however, quite different as here shown, and as one of them, *O. tomentosa*, is in cultivation, it seems desirable that their distinguishing features should be recorded.

O. dentata, Moench, was founded on *Aster dentatus*, Andr. Bot. Rep. t. 61 (1797), where it is well figured; whilst *O. tomentosa* was clearly depicted and described by Schrader in Wendl. Sert. Hann. 8, t. 24 (1798).

The diagnostic features and synonymy of the two species are as follows:—

O. dentata, *Moench*, Meth. Suppl. p. 254 (1802).

Folia ovata vel ovato-rotundata, sinuato-dentata vel crenata, involucri bracteae extra fere glabrae, apice breviter ciliatae. —Benth. Fl. Austral. vol. iii. p. 472 partim. *Aster dentatus*, Andr. Bot. Rep. t. 61 (1797); non Thunb. *Aster ferrugineus*, Wendl. in Flora, 1819, p. 676. *Diplopappus rotundifolius*, Less. in Linnaea, vol. vi. p. 116 (1831). *Olearia rotundifolia*, DC. Prodr. vol. v. p. 271 (1836).

Distrib.—New South Wales: near Port Jackson, *Gaudichaud; Clowes* 260; *Fraser; Sieber* 341; *R. Brown* 2230; *Hooker; Herb. Forsyth*. Richmond River, *C. Moore*. Illawarra, *Backhouse*.

O. dentata was first grown in this country by Messrs. Lee & Kennedy, the Hammersmith Nurserymen, who raised it in the year 1793 from seeds collected in the vicinity of Port Jackson, New South Wales. It seems to have gone out of cultivation.

O. tomentosa, *DC.* Prodr. vol. v. p. 252 (1836).

Folia plerumque obovata, subintegra vel undulata; involucri bracteae dense et molliter tomentosae.—*Aster tomentosus*, Schrad. in Wendl. Sert Hann. 8, t. 24 (1798). *Olearia dentata*, Benth. Fl. Austral. vol. iii. p. 472, partim; non Moench.

Distrib.—New South Wales: Port Jackson, *Cunningham; R. Brown* 2231.

Cultivated in the Hanover Garden in 1798; Schrader (l.c.) gives the habitat as "Caput bonae spei," but this was no doubt a mistake. The species was grown outdoors in the Scilly Islands in 1872, and it probably still grows there, for the cultivated plants in the Temperate House at Kew were obtained from Major Dorrien Smith in 1911 under the name *O. dentata*.

The species of *Olearia* are best classified by the structure of the hairs on the under-surface of the leaves, the different types of hairs being simple, T-shaped, stellate, woolly, or viscid, and the groups defined in this way are remarkably natural and easily recognised. Both the species under discussion have the T-shaped 1-celled hairs which are characteristic of the section *Dicerotriche*. In *O. dentata* the branches of the hairs are very long with the stalk about half as long, whilst in *O. tomentosa* the branches are not so long and the stalk is scarcely a quarter of their length.

J. H.

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ROYAL BOTANIC GARDENS, KEW.

BULLETIN

OF

MISCELLANEOUS INFORMATION.

No. 3] [1917

XII.—THE COLLECTION OF VINES (VITIS, ETC.) AT KEW.

(With Plate.)

The collection of hardy species and varieties of *Vitis* and allied genera at Kew is grown on a pergola running N.N.E. from near the Pagoda towards the Ruined Arch, and parallel with the avenue of Robinias and Gleditschias. This was erected and the vines planted in the autumn of 1912 (see *K.B.* 1913, p. 51). For some forty years previously the collection had been grown on a curving line of iron posts between the North Gallery and the Maple collection. The posts were so short that the plants had to be treated as bushes rather than climbers. They stood their removal to new quarters very well, and few were lost. As may be judged from the accompanying illustration, they have succeeded admirably and in four seasons have almost clothed their supports.

As garden ornaments this group of climbers have no flower beauty to recommend them, nor, in our climate, can we expect them to bear and ripen fruit to any great extent in the open ground. Their value lies in the noble proportions or handsome cutting of their foliage, their vigour of growth, but above all in the richness of the autumnal colouring.

Since the publication of the *Genera Plantarum* in 1862 the vines at Kew have been labelled in accordance with Bentham and Hooker's conception of *Vitis*. These authors made it include, besides *Vitis* proper, *Ampelopsis* and *Cissus*. The late Mr. Planchon published a valuable monograph of the *Ampelidae* in 1887 (De Candolle's *Monographiae Phanerogamerum* vol. v.), and since then there has been a disposition generally to adopt his views as to generic limitations in this family. Following his classification, the hardy or nearly hardy species in cultivation at Kew are, in the subjoined list, divided amongst the genera *Vitis*, *Ampelopsis*, *Parthenocissus* and *Cissus*.

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Species Cultivated at Kew.

Vitis, *Linn.*

V. aestivalis, Mich. United States.
V. amurensis, Rupr. Manchuria, Corea, N. China.
V. arizonica, Engelm. S.W. United States.
V. armata, Diels et Gilg. China.
V. armata var. *Veitchii*, Hort. China.
V. Baileyana, Munson. S.E. United States.
**V. Berlandieri*, Planch. S.W. United States.
V. bicolor, Le Conte. United States.
V. Bourquiniana, Munson. United States.
V. californica, Benth. W. North America.
**V. candicans*, Engelm. Texas.
V. Champinii, Planch. S.W. Texas.
V. cinerea, Engelm. United States.
V. Coignetiae, Pull. Japan.
V. cordifolia, Michx. United States.
**V. Doaniana*, Munson. Texas and New Mexico.
V. ficifolia, Bunge. China.
**V. flexuosa*, Thunberg. Japan and Corea.
**V. flexuosa*, var. *Wilsoni*, Veitch. China.
V. Labrusca, L. E. North America.
V. Longii, Prince. S.W. United States.
**V. monticola*, Buckl. Texas.
V. palmata, Vahl. S. United States.
V. Pagnucci, Rom. du Caill. China.
V. Piasezkii, Maxim. Central China.
V. pulchra, Rehder. China.
V. Romanetii. Rom. du Caill. China.
**V. rotundifolia*, Michx. S. United States.
V. rupestris, Scheele. S.E. United States.
V. Thunbergii, S. et Z. Japan.
V. Treleasei, Munson. S.W. United States.
V. vinifera, L. S.E. Europe and Asia Minor.
V. vinifera var. *apiifolia*, Loudon. Garden Origin.
V. vinifera var. *corinthiaca*, "Currant Grape," Greece.
**V. vinifera* var. *incana*, "Miller Grape." Garden Origin ?
V. vinifera var. *purpurea*, "Teinturier Grape." Garden Origin.
V. vulpina, L. E. North America.

The species marked * are missing from the collection, having been lost in transplanting. Cuttings or plants of them would be welcomed.

Ampelopsis, *Michx.*

A. aconitifolia, Bunge. China.
A. aegyrophylla, Planch. Persia to Turkestan.
A. arborea, Koehne. S. United States.
A. brevipedunculata, Koehne. N.E. Asia.
A. citrulloides, Hort. Hab.?
A. cordata, Michx. (Vitis indivisa, *Willd.*) S. United States.
A. Delavayana, Franch. W. China.

A. heterophylla, S. et Z. China, Japan, Corea.
A. heterophylla var. *elegans*, Regel. Garden Origin.
A. megalophylla, Diels. W. China.
A. micans, Rehd. (Vitis repens, *Veitch*.) W. China.
A. micans var. *cinerea*, Rehd. W. China.
A. orientalis, Planch. Asia Minor, Syria.

Parthenocissus, *Planchon.* (**Psedera,** *Necker.*)

P. Henryana, Diels et Gilg. China.
P. Henryana var. *glaucescens*, Diels et Gilg. (V. Thomsoni, *Veitch; non Laws.*) China.
P. himalayana, Planch. Himalaya.
P. himalayana var. *rubrifolia*, Gagnep. W. China.
P. laetevirens, Rehd. Central China.
P. quinquefolia, Graeb. North America.
P. quinquefolia var. *hirsuta*, Rehd. S.E. United States.
P. quinquefolia var. *murorum*, Rehd. S. United States.
P. semicordata, Planch. Himalaya.
P. sinensis, Diels et Gilg. China.
P. tricuspidata, Planch. (Vitis inconstans, *Miq.*) China, Japan.
P. tricuspidata var. *Lowi*. Garden Origin.
P. vitacea, Hitchc. North America.
P. vitacea var. *laciniata*, Rehd. North America.
P. vitacea var. *macrophylla*, Rehd. (var. major, *Hort.*)

Cissus, *Linn.*

C. striata, Ruiz et Pav. Chile.

XIII.—REVISION OF ASPIDOPTERYS.

J. Hutchinson.

Aspidopterys is a genus of about 20 species of tall climbing shrubs, native of the forests of India, and of the Malay Archipelago. It may be recognised in the family *Malpighiaceae* by its opposite leaves, eglandular calyx, sessile entire petals, ten stamens, three styles, and the nucleus of the fruit (samara) completely surrounded by the broad, oblong, ovate or orbicular membranous shield-like wing. Although the fruits are so well adapted for dispersal by the wind, the majority of the species are extremely limited in their distribution. In this respect it is noteworthy that the species with the largest samara (fig. 14) is the most widely dispersed. This is *A. elliptica*, A. Juss., which occurs in Java, Borneo and the Philippine Islands. It is probably also represented in Tonkin by *A. macrocarpa*, Dop, a species not known to the writer, but which appears to be very closely related if not identical. Another species with a considerable distribution is *A. concava* (fig. 10), with extremely light membranous fruits, which occurs from Burma through the Malay Peninsula and Indo-China to the Island of Borneo.

The shape of the fruits is apparently of primary importance in the classification of the species, and in the present revision two sections have been established on this feature. Then in several species the presence or absence of clothing hairs above the articulation of the pedicel is an easily distinguishable character which has evidently not received sufficient attention.

The Indian species remain as defined by Sir J. D. Hooker in the Flora of British India, with the exception of his "A. Roxburghiana," which, there is little doubt, covers three distinct species, (1) *A. indica*, (Roxb.) Hochr., from the Cuddapah District of Madras, (2) *A. glabriuscula*, A. Juss., from Sikkim, Bhotan, Assam and Yunnan, and (3) *A. oxyphylla*, A. Juss., from Sylhet and the Khasia Hills. The first two species have amongst other differences elongate, more or less oblong or lanceolate fruits, the last orbicular fruits (fig. 16), a fact not known to Hooker for want of adequate material.

The distribution of the genus in the Malay Archipelago is entirely confined to the Western Islands, *i.e.*, to the Indo-Malayan Region as defined by Wallace (see The Malay Archipelago, p. 13, and physical map), and in the case of this small genus supports in a striking manner his conclusions, which were based principally on a study of the fauna of the Archipelago.

The writer is much indebted to the Keeper, Botanical Department, Natural History Museum, South Kensington, for affording facilities in the examination of the material under his charge, and to the Regius Keeper, Royal Botanic Garden, Edinburgh, for the loan of material.

The distribution of the species is shown in the table on p. 102.

Clavis specierum.

I. **Oblongae,** sect. nov.—*Samara oblonga vel lineari-oblonga vel ovato-lanceolata, multum longior quam lata, marginibus plerumque plus minusve parallelis:—*

Ramuli et inflorescentiae rhachis plus minusve pilis debilibus patulis dense hirsuta; folia brevissime petiolata, basi conspicue cordata, abrupte caudato-acuminata, dense ciliata ... ... 1. *hirsuta.*

Ramuli et inflorescentiae rhachis glabra vel breviter pubescens; folia plerumque sensim acuminata, haud ciliata, basi rarius cordata:—

Folia matura infra plus minusve dense ferrugineo-tomentosa vel villosa:—

Sepala extra glabra:—

Sepala haud ciliata; species yunnanensis 2. *Henryi.*

Sepala ciliata; species javanensis ... 10. *tomentosa.*

Sepala extra villosa; species indochinensis ... ... 3. *Thorelii.*

Folia matura infra glabra vel solum in nervis breviter pubescentia :—
Pedicelli supra articulationem et calyx glaber ... ... 4. *floribunda.*
Pedicelli supra articulationem et calyx conspicue pubescens :—
Samara elongata et angusta, utrinque aequilata vel leviter angustata; species maderaspatensis ... ... 5. *indica.*
Samara plus minusve ovata vel lanceolata, apicem versus angustata; species ind. orient. borealis ... ... 6. *glabriuscula.*

II. **Orbiculares,** sect. nov.—*Samara orbicularis vel suborbicularis, plerumque vix longior quam lata :—*
Flores axillares, simpliciter pedicellati vel in racemos brevissimos dispositi; ramuli longitudinaliter sulcati, cortice glabro cinereo obtecti; folia elliptica vel obovato-elliptica, obtusissime et sensim acuminata, basi breviter cuneata, glabra; samara membranacea ... ... 7. *canarensis.*
Flores in paniculas vel cymas multiramosas dispositi :—
*Pedicelli supra articulationem glabri :—
†Rhachis inflorescentiae et saepe ramuli et foliorum pagina inferior conspicue et frequenter dense pubescens :—
Fructus dorso inter-alias crista lata instructus :—
Folia utrinque plus minusve cordata, apice prominenter cuspidata, infra molliter tomentosa ... 8. *obcordata.*
Folia solum ad basin cordata vel rotundata, plus minusve sensim acuminata :—
Folia orbicularia vel late ovato-orbicularia, fere lata quam longa :—
Folia circiter 8 cm. lata; petioli dense ruto-tomentosi :—
Folia infra solum in costa pubescentia, nervis tertiariis supra conspicuis... 9. *Helferiana.*
Folia infra ubique molliter tomentosa, nervis tertiariis supra inconspicuis 10. *tomentosa.*
Folia 9–13 cm. lata; petioli minute appresse pubescentes vel fere glabri ... 11. *Cavaleriei.*
Folia oblongo - elliptica, multo longiora quam lata; samara membranaceo-hyalina ... 12. *concava.*

Fructus dorso inter alias ecristatus vel basin versus leviter carinatus :—
Folia orbicularia vel ovato-lanceolata et etiam infra plus minusve dense pubescentia, basi rotundata; pedicelli supra articulationem glabri ... ... 13. *nutans.*
Folia orbicularia, basi cordata, acumine basi lato; pedicelli supra articulationem interdum pubescentes ... ... 21. *cordata.*
Folia lanceolata, longe acuminata, infra glabra ... ... 14. *oxyphylla.*
††Rhachis inflorescentiae et saepe ramuli glabri vel fere glabri; folia infra glabra :—
Samara matura probabiliter infra 2 cm. diametro ... ... 15. *andamanica.*
Samara matura circiter 4 cm. diametro :—
Samara plus minusve orbicularis ... 16. *elliptica.*
Samara ovato-orbicularis; species non visa ... ... 17. *macrocarpa.*
**Pedicelli supra articulationem pubescentes vel subtomentosi; folia infra plerumque tomentosa :—
Sepala extra dense villosa ... ... 18. *Esquirolii.*
Sepala extra glabra vel glabriuscula :—
Sepala ciliata; folia saepe haud cordata :—
Folia infra plerumque dense tomentosa; samara dorso ecristata ... 19. *Wallichii.*
Folia infra glabra; samara dorso conspicue cristata ... ... 20. *Harmandiana.*
Sepala haud ciliata; folia plerumque cordata ... ... 21. *cordata.*

1. **A. hirsuta,** *A. Juss.* in Ann. Sci. Nat. Ser. II. xiii. 267 (1840), et Monogr. Malpigh. 258, t. xvii. 27 (1843); Hook. f. Fl. Brit. Ind. i. 421 (1874); Kurz, For. Fl. Burma, i. 176 (1877); Craib in Aberdeen Univ. Stud. no. 57, 31 (1912). *Hiraea hirsuta,* Wall. Pl. As. Rar. 1. 13, t. 13 (1830); Wall. Cat. 1059.

Burma. Prome district; Taong dong and the Prome Mts., *Wallich* 1059; Katha district; Pyide Reserve, Nov., fr. *Lace* 4489; *Hort. Serampore.*

Siam. Doi Sootep, mixed jungle, 450 m., Oct., fls., *Kerr* 1448.

2. **A. Henryi,** *Hutchinson,* sp. nov.

Scandens; ramuli patentes, dense ferrugineo-tomentosi, subteretes. *Folia* late ovata vel ovato-orbicularia, breviter acute acuminata, basi rotundata vel leviter cordata, 8-10 cm. longa, 5–7 cm. lata, tenuiter chartacea, supra glabra, minute foveolata,

infra dense ferrugineo-tomentosa, evenosa; nervi laterales utrinsecus circiter 6, arcuati, dense hirsuti; petioli 0·7–1 cm. longi, ferrugineo-hirsuti. *Inflorescentiae* racemoso-paniculatae, basin versus foliatae, terminales et laterales, usque ad 25 cm. longae, ubique dense ferrugineo-tomentosae; rami sub angulo 90° divergentes, usque ad 6 cm. longi, demum in fructu 15 cm. longi; ramuli ultimi usque ad 1 cm. longi, graciles, bracteis parvis hirsutis subtendentibus; pedicelli fasciculati, 4–6 mm. longi, gracillimi, basin versus articulati, supra articulationem glabri. *Sepala* 5, subaequalia, elliptica vel elliptico-obovata, submembranacea, 1·25 mm. longa, 0·75 mm. lata, glabra pilis paucis apicem versus exceptis. *Petala* 5, obovata, 4–5 mm. longa, circiter 2 mm. lata, glabra. *Stamina* 10; filamenta basi connata, glabra; antherae late ellipsoideae, 1 mm. longae. *Ovarium* parce setosum; styli 2·5 mm. longi, glabri, stigmatibus capitatis subglobosis nigrescentibus. *Samara* elongato-oblonga, 3·5–4 cm. longa, 1·5–1·8 cm. lata, laxe reticulata, glabra; pedicelli fructiferi 1·5–2 cm. longi.

China. Yunnan: Mengtze, south eastern forests, 1650 m., *A. Henry* 11055A.

3. **A. Thorelii,** *Dop* in Bull. Soc. Bot. France, lv. 428 (1908), et in Lecomte, Fl. Indo-Chine, i. 602, fig. 64, 5 (1911).

French Indo-China. Laos: Mekong river valley, near Lakhon, *Thorel* 3037.

An example of this species has not been seen. The fruit figured by Lecomte (l.c.), which I have reproduced on the plate (fig. 3), is said to be natural size, and must be the smallest yet known in the genus.

4. **A. floribunda,** *Hutchinson*, sp. nov.

Frutex alte scandens; ramuli ultimi subteretes, cortice brunneo parce appresse pubescente obtecti. *Folia* elliptica vel ovato-elliptica, breviter acute acuminata, basi rotundata vel leviter cordata, 7–11 cm. longa, 4–6·5 cm. lata, tenuiter chartacea, supra glabra, subnitida, infra costa et nervis appresse pubescentibus exceptis glabra; nervi laterales utrinsecus 4–5, arcuati; petioli 0·7–1 cm. longi, parce pubescentes. *Inflorescentia* paniculata, multiflora, usque ad 30 cm. longa et 15 cm. expansa, breviter ferrugineo-pubescens; bracteae lineari-lanceolatae, acutae, usque ad 8 mm. longae, appresse ferrugineo-tomentosae; pedicelli fasciculati, graciles, basin versus articulati, supra articulationem glabri, usque ad 0·8 cm. longi. *Sepala* elliptico-obovata, apice rotundata, circiter 1 mm. longa, glabra, margine anguste membranacea. *Petala* elliptico-obovata, 3·5–4 mm. longa, glabra. *Stamina* stylis paullo breviora; filamenta glabra; antherae 0·65 mm. longae. *Ovarium* glabrum; styli glabri. *Samara* oblonga vel oblongo-lanceolata, apicem versus angustata, 4–5 cm. longa, 1·7–2·3 cm. lata, membranacea, straminea, conspicue nervosa et reticulata.

China. Yunnan: Puerh, 1500 m., fls., *A. Henry* 10455B; Mengtze, mountain cliffs, 1620 m., fr., *A. Henry* 10455; western

flank of the Shweli-Salwin divide, amongst scrub, Aug., fls., *Forrest* 9127 (Herb. Edinb.).

India. Assam: "Assam and Khasia Hills," *Simons* (Dehra Dun Herb.); Cachar, *Keenan*.

5. **A. indica,** *Hochreut.* in Bull. Inst. Buitenz. xix. 45 (1904).

Triopteris indica, Roxb. Cor. Pl. ii. 32, t. 160 (1798); Willd. Sp. Pl. ii. 744 (1799). *Hiraea indica*, Roxb. Hort. Beng. 90 (1814), et Fl. Ind. ii. 448 (1832); DC. Prodr. i. 585 (1824); Wall. Pl. As. Rar. i. 13 (1830). *Aspidopterys Roxburghiana*, A. Juss. in Ann. Sci. Nat. Ser II. xiii. 267 (1840), et Monogr. Malpigh. 257, excl. Wall. 1057 (1843); Hook. f. Fl. Brit. Ind. i. 420, excl. vars. et syn. A. Juss. (1874).

India. Madras: Cuddapah, 330 m., Oct., fls., *Gamble* 18242; *Beddome* 815 (*Herb. Brit. Mus.*); Seshachalam hills, *Hon. W. Elliot in Herb. Cleghorn;* Palkonda, Oct., fr., *Campbell* (Herb. Brit. Mus.); Nandaradah, *Rottler*. "Western Peninsula," without precise locality, *Herb. Wight* 297, 920; *Roxburgh* (Herb. Edinb.); *Cleghorn* 42 (Herb. Edinb.); *Russel* (Herb. Brit. Mus.).

A. indica, *A. glabriuscula* and *A. oxyphylla* were included in one species, *A. Roxburghiana*, A. Juss., in the Flora of British India. They may be readily distinguished from one another by their fruits, as shown in the key, and *A. indica* is, in addition, confined to the Western Peninsula, probably entirely to Madras, whilst the other two occur in Sikkim and Assam, with *A. glabriuscula* extending into Southern Yunnan. I have not seen mature fruits of *A. oxyphylla*, but the half-ripe examples of Clarke's specimens are already almost orbicular, and of a very different shape from those of the other two species, where they are oblong or oblong-lanceolate. The fruits of *A. oxyphylla* were not known to Hooker.

6. **A. glabriuscula,** *A. Juss.* in Ann. Sci. Nat. Ser. II. xiii. 267 (1840), et Monogr. Malpigh. 257 (1843). *Hiraea glabriuscula*, Wall Cat. 6626. *Aspidopterys Roxburghiana*, var. 2, Hook. f. Fl. Brit. Ind. i. 420.

India. Sikkim: Pomong, 1000 m., Aug., fls., *Clarke* 8811; Ryhap, Oct., fr., *Clarke* 13491; lower hills, *Hooker;* Lingcham, 1600 m., Oct., *Clarke* 25474 A; without definite locality, *Thomson* (Herb. Edinb.). Bhotan, *Griffith* 663 (Herb. Edinb.). Assam: Khasia Hills; *Kurz* (Herb. Edinb.); *Jenkins; Griffith* 386, 919; *Lobb;* 600–1620 m., *Hooker* and *Thomson;* Nunklow, July 13, 1850, *Hooker* and *Thomson* (No. 1689); Myrung, July 26, 1850. *Hooker* and *Thomson;* Mishmee, *Griffith;* Jaintea Hills; Nurtrung, Oct. 1, 1850, *Hooker* and *Thomson;* Mooshye, 600–1600 m., Sept. 24, 1850, *Hooker* and *Thompson;* Jowye, 1300 m., Oct., *Clarke* 6008; Churra, Aug. 12, 1850, *Hooker* and *Thomson; Wallich* 6626. Naga Hills; Kohima, 1800 m., Oct., *Clarke* 41753.

China. Yunnan: Szemao, forests to the north-west, 1640 m., *A. Henry* 10455 A (Herb. Edinb.).

See note under *A. indica*.

7. **A. canarensis,** *Dalz.* in Hook. Kew Journ. Bot. iii. 37 (1851); Hook. f. Fl. Brit. Ind. i. 420 (1874); Talb. Trees Bomb. 29 (1894); Woodr. in Journ. Bomb. Nat. v. ii. 265 (1897); Cooke, Fl. Bomb. i. 159 (1901); Gamble, Fl. Madras i. 129 (1915). *A. glomerata,* Wight, Ic. t. 1986 (1853).

India. Bombay: near Bombay, *Dalzell;* Concan, *Stocks;* North Kanara; evergreen forests of the Supa Ghâts, *Talbot;* Kumta and Sirsi Road, *Woodrow;* Nilkund, *Woodrow;* South Kanara; Mangalor, *Hohenacker* 2355; Gudda Badschagee, *Hohenacker. Mysore: Cleghorn,* Apr., fls. *Wight;* without definite locality, *Wight* 567.

8. **A. obcordata,** *Hemsl.* in Hook. Ic. Pl. t. 2673 (1900).

China. Yunnan: Fulo forests to the south of Szemeo, 1600 m., fls. white, *A. Henry* 12894.

Siam. Ban Ta kaw, near Wieng Papao, 550 m., Mar., fls., *Kerr* 2516; Me Khan, Mar., fls. and fr., *Linit* 68.

Burma. Tharrawaddy district; Myodwin, Mar., fls., *Lace* 5712; Pegu district; Aingdou-Kun Reserve, Mar., fls., *Lace* 6109; Shan Hills, 650 m., Mar., fls., *Collett* 433.

A very distinct species with the triangular acumen of the leaves protruding from a wide and often fairly deep sinus, the leaf being in outline cordate at both ends.

9. **A. Helferiana,** *Kurz* in Journ. As. Soc. Beng. xliii. ii. 137 (1874), partim, excl. *Wallich* 1057.

Burma. Tenasserim: Moulmein district, *Helfer* 923; *Falconer*, partim (quoad folia in Herb. Edinb.).

10. **A. tomentosa,** *A. Juss.* in Ann. Sci. Nat. Ser. ii. xiii. 267 (1840); Miq. Fl. Ind. Bat. i. ii. 586 (1859); Hochreut. Cat. Bog. Nov. i. 45 (1904). *Hiraea tomentosa,* Blume, Bijdr. 225 (1825).

Malay Archipelago. Java: Parang, *Horsfield* 915; Buitenzorg, *Hochreutiner* 34.

I have not seen fruits of this species, and have therefore put it into two places in the key. Its natural position, however, seems to be nearest *A. Helferiana,* and probably the fruits when known will prove to be orbicular as in that species.

11. **A. Cavaleriei,** *Léveillé* in Fedde, Repert. ix. 458 (1911). *A. Dunniana,* Léveillé, l.c. xi. 65 (1912).

China. Kou-chow: Lofou, Apr., fls., *Cavalerie* 2993; Lungchow, *Morse* 512.

M. Léveillé seems to have described this species twice, for *Cavalerie* 2993 is quoted in each of the publications cited, and the two descriptions do not point to any mixture in this number.

12. **A. concava,** *A. Juss.* Monogr. Malpigh. 255 (1843); Hook. f. Fl. Brit. Ind. i. 420; Kurz, For. Fl. Brit. Burma, i. 175; King et Gamble, Mat. Fl. Mal. Penins. i. 195. *Hiraea concava,* Wall. Pl. As. Rar. i. 13 (1830); Wall. Cat. 1061. *H. merguensis,* Wight, Ill. i. 139 (1840). *Aspidopterys albo-marginata,* Hance in Journ. Bot. 1877, 330; Dop in Lecomte, Fl. Indo-Chine, i. 602 (1911).

Burma. Martaban, *Wallich,* 1061; Moulmein, *Falconer* partim (quoad samaras in Herb. Edinb.); Mergui, *Griffith* 20.

Malay Peninsula. Selangor district; Damansara Hill, Mar., fr., *Ridley;* Penang; Government Hill, 330 m., Feb., fls., *Curtis* 138; 160 m., Apr., fr. *Curtis* 798; 330 m., Jan., fls., *Curtis* 3537.

Indo-China. Cambodia: Kamchay; near Kampot, *Pierre* 19315.

Malay Archipelago. Borneo: Sarawak; near Kuching, Jan., fls., *Haviland* and *Hosie* 3732 K; Rejang, Apr., fls., *Haviland* 2857. Sumatra: without definite locality, *Forbes* 2941 (Herb. Mus. Brit.).

A large woody climber reaching to the tops of tall trees, almost leafless at this season (January), flowers white (*Curtis* 3537).

13. **A. nutans,** *Hook. f.* Fl. Brit. Ind. i. 421, non A. Juss. (1874); Kurz, For. Fl. Burma, i. 175 (1877); Lecomte, Fl. Indo-Chine, i. 601 (1911); Craib in Aberdeen Univ. Stud. no. 57, 31 (1912).

Hiraea nutans, Roxb. Fl. Ind. ii. 447 (1832). *H. orbiculata,* Roxb. Hort. Beng. 90 (1814); Wall. Pl. As. Rar. i. 13 (1830). *H. rotundifolia,* Roxb. l.c. 448. *H. indica,* Wall. Cat. 1057, partim, non Roxb. *H. lanuginosa,* Wall. Cat. 1058, partim, quoad spec. foliis villosis. *Aspidopterys Roxburghiana,* A. Juss. Monogr. Malpigh. 257, partim, quoad Wall. 1057; *A. lanuginosa,* A. Juss. l.c. 258; *A. rotundifolia,* A. Juss. l.c. 260; Prain, Beng. Pl. 290; *A. Roxburgiana, forma,* Hosseus in Beih. Bot. Centralbl. xxviii. 403.

India. Oudh: forests north of Oudh, fr.. *R. Thomson* 406. Nepal, fls. and fr., *Wallich* 1058. Sikkim: Darjeeling distr.; between Badamtam and Ranjeet River, 650 m., Aug., fls., *Lace* 2359; Ranjeet, 360 m., Aug., *Clarke* 27112 C.; Great Rungut, Aug., fls. and fr., *Hooker;* Budum Than 1300 m., Aug., fls., *Clarke* 27075 A, 27075 C; Sookna, Dec., fr., *Clarke* 31708 B, 31708 H; Panchkilla, 350 m., June, fls., *Clarke* 26557 A; without definite locality, *Griffith* 917, 924; *Treutler* 1071; *Beddome* 817 (Herb. Mus. Brit.). Eastern Bengal: Chittagong, *Wallich* 1057/2 (Herb. Bruce); Calcutta Bot. Gard., *Herb., Wallich* 1057/1. Assam: Upper Assam, *Jenkins* 617; Goalpara, *Hamilton* 1093 and in *Herb. Wallich* 1057; Cachar side of Kala Naga hills, May, *Watt* 6903; "Assam and Khasia Hills," *Simons.*

Burma. Chin Hills, Oct., *Abdul Huk* 53; Ponsshee, on the Yunnan border, *Anderson;* Bhamo, Jan., fr., *Anderson;* banks

of the Irrawadi at Bhamo, amongst scrub, Nov., fls. and young fr., *Forrest* 9238; Thôndaung, 850 m., Aug., fls., *Lace* 5911; without definite locality, *Beddome* 816 (Herb. Mus. Brit.).

Siam. Me K'Mi, Feb., fr., *Kerr* 2354; Paknampo, Sept., fls., *Hosseus* 21.

French Indo-China. Laos: Kemmarath, *Thorel.* Cambodia: Bang-nuoc, *Thorel.*

I have not seen any specimens from Indo-China, those quoted being the records in Lecomte, Fl. Indo-Chine, l.c.

14. **A. oxyphylla,** *A. Juss.* in Ann. Sci. Nat. Ser. ii. xiii. 267 (1840).

Hiraea oxyphylla Wall. Cat. 7264. *Aspidopterys Roxburghiana*, Hook. f. Fl. Brit. Ind. i. 420, partim.

India. Assam: Sylhet, *Wallich* 7264. Khasia Hills; Theria, 620 m., Oct., fls. and young fr., *Clarke* 44919 A, 44919 B, 44919 F; Mahadeo, 800 m., Oct., fls., Clarke 44913 A.

15. **A. andamanica,** *Hutchinson*, sp. nov.

A. Helferiana, King, Mat. Fl. Mal. Penins. No. 6, 195, partim, non Kurz.

Frutex scandens; ramuli ultimi teretes, appresse pubescentes, demum glabri. *Folia* late elliptica vel oblongo-elliptica, basi rotundata vel cordata, apice abrupte et obtuse acuminata, 10–15 cm. longa, 5–9 cm. lata, acumine 1–1·5 cm. longo, tenuiter chartacea, utrinque glabra et subnitida; costa supra impressa, infra conspicua; nervi laterales utrinsecus 5–6, a costa sub-angulo 45°–70° abeuntes, supra prominuli, infra prominentes; nervi tertiarii a costa media sub angulo 90° divergentes, infra conspicui; petioli 1–1·5 cm. longi, glabri, supra profunde canaliculati. *Inflorescentia* multiflora, terminalis et axillaris, foliis brevior; rhachis fere glabra; pedicelli subfasciculati, graciles, circiter 1 cm. longi. *Sepala* oblongo-elliptica, apice rotundata, circiter 2 mm. longa. glabra. *Petala* obovata, 5–6 mm. longa, glabra. *Antherae* 2 mm. longae. Fructus vix maturus orbicularis, 1·7 cm. diametro, glaber, dorso breviter cristatus, sicco nigro-purpureus.

Andaman Islands. Shore Point at Port Blair, July, *King's Collector* 50; Cadellganj Hill jungle, Aug., *King's Collector;* without definite locality, *King's Collector* 417; Namunaghar, hill jungle, *King's Collector* (10.9.1892).

16. **A. elliptica,** *A. Juss.* in Ann. Sci. Nat. Ser. ii. xiii. 266 (1840).

Ryssopteris ovata, Turcz. in Bull. Soc. Nat. Mosc. xxxvi. i. 583 (1863). *Combretum sexalatum*, Merrill in Philipp. Journ. Sci. i., Suppl. 212, partim, quoad fructus (1906). *Aspidopterys ovata*, Merrill et Rolfe in Philipp. Journ. Sci. iii. 106 (1908).

Malay Archipelago. Java: *Blume* 25 (Herb. Brit. Mus.); *Lobb; Zollinger* 17207. Borneo: Bangarmassing, *Motley* 402; Tinkalayo, *Creagh;* Tanjong, Batu, *Creagh.*

Philippine Islands. Luzon: Albay Province, *Cuming* 941, 945; Macaharing, *Loher* 175; Novaliches, Feb., fr., *Loher* 5138; Bosoboso, Rizal Province, fls., June, *Ahern's Collector* 1163, 3126; fr., Sept., *Ahern's Collector* 1868, 3321; Bosoboso, fls., July, *Merrill* 2811; Lucena, fls., June. *Merrill* 2891; Montalban, fls., May, *Loher* 5772. Masbate Island: fls., Nov., *Merrill* 3380. Ticao Island: fls., Mar., *Vidal* 2242. Panay Island: fr., Mar., *Vidal* 2738. Mindanao: Cadabaran, *Elmer* 13377.

Of the Philippine Islands specimens I have seen only those from Luzon; the remainder are those quoted by Merrill and Rolfe (l.c.).

17. **A. macrocarpa,** *Dop* in Bull. Soc. Bot. France, lv. 428 (1908), et in Lecomte, Fl. Indo-Chine i. 603 (1911).

Indo-China. Tonkin: Neighbourhood of Ninh-binh, *Bon* 2283.

I have not seen an example of this species. The fruits figured by Lecomte, reproduced on the accompanying plate (fig. 15), are very similar to those of *A. elliptica* from the Malay Archipelago.

18. **A. Esquirolii,** Léveillé in Fedde, Repert. xi. 65 (1912).

China. Kow-chow: Houa-Kiang, June, fls., *Cavalerie* 2032; Aug., *Esquirol* 593.

This species may be at once recognised in the genus by the externally densely hairy sepals.

19. **A. Wallichii,** *Hook. f.* Fl. Brit. Ind. i. 421 (1874).

Hiraea nutans, Wall. Pl. As. Rar. i. 13 (1830), et Cat. 1056, 1, non Roxburgh: *H. lanuginosa,* Wall. l.c., et Cat. 1058, partim, non A. Juss. *A. nutans,* A. Juss. in Ann. Sci. Nat. Ser. ii. xiii. 267 (1840), non Hook. f.

India. Eastern Punjab: Sirmur; Banasur, *Edgeworth* 289; Hort. Govan, *Wallich* 1058; Simla, Aug., fls., *Lady Dalhousie* (Edinb. Herb.); Garhwal: June, fls., *Thomson* 1328. Kumaon: Ramganga Valley, below Bans Kumaon, 1000 m., *Reid;* without precise locality, *Blinkworth in Herb. Wallich* 1056, 1, and *Herb. Heyne* 1056; Gungoli, 1300 m., *Strachey* and *Winterbottom* 1. Dehra Dun district, Nov. and Jan., fr., *Gollan* (B specimen in Herb. Dehra Dun); ravines, Aug., fls., *Duthie* 1427; *Madden; Duthie's Collector* (*Harsukh*) in Edinb. Herb.; Dec., fr., *Kanjilal; Schlich* (Edinb. Herb.). Saharanpur: Dholhhand, Nov., fr., *Gamble* 23986; Khairana, Oct., fr., *Omaston* 259. Oudh: Sarju Valley, 600-950 m., Aug., fls., *Duthie* 5405.

The type specimen of *Hiraea nutans,* Wallich (not of Roxb.), was "gathered by one of my plant-collectors on the lower range of hills at Kamoon," (Wallich l.c. i. 13); this refers no doubt to Blinkworth's gathering quoted above, which may therefore be looked upon as the type of *A. Wallichii.*

26. **A. Harmandiana,** *Pierre,* For. Fl. Cochinch. t. 275 (1893); Dop in Lecomte, Fl. Indo-Chine, i. 602 (1911).

French Indo-China. Laos: Attopeu, *Harmand;* Kemmarath, *Thorel.* Cambodia: Bang-nuoc, *Thorel.*

21. **A. cordata,** *A. Juss.* in Ann. Sci. Nat. Ser. ii. xiii. 267 (1840); Hook. f. Fl. Brit. Ind. i. 421 (1874); Dalz. et Gibs. Fl. Bomb. 34 (1861); Talb. Trees, Bomb. 29 (1894); Woodr. in Journ. Bomb. Nat. v. ii. 265 (1897); Cooke, Fl. Bomb. i. 158 (1901). *Hiraea cordata,* Heyne in Wall. Cat. 1060. Wall. Pl. As. Rar. i. 13 (1830). *Hiraea nutans,* Wall. Cat. 1058, 2.

India. Bombay: Thana district; Salsette Island, *Jacquemont* 991; Konkan, *Stocks;* Poona, *Woodrow* (Edinb. Herb.); hills near Matheran, without collector in *Poona Coll. of Sci. Herb.* (Edinb. Herb.); Singpur, without collector in *Poona Coll. of Sci. Herb.* (Edinb. Herb.); Belgaum, *Ritchie* 161 (Edinb. Herb.); *Ritchie* 101 (Kew Herb.); North Kanara; Yellapur, Oct., fls., *Talbot;* "Bombay," *Dalzell.* Mysore: Shimoga, 660–960 m., Oct., fls., *Meebold* 10805; without precise locality, *Wight* (Herb. propr.) 359; *Wight* (Kew. Distrib. 296); *Rottler.*

In this species the pedicels above the articulation are always more or less hairy, but they are frequently glabrous towards the apex.

Imperfectly known species.

22. **A. costulata,** *Pierre,* For. Fl. Cochinch. sub. t. 275 (1893); Dop in Lecomte, Fl. Indo-Chine, 604 (1911). *A. tomentosa,* Pierre, l.c. non A. Juss.

French Indo-China. Cochin China: Province of Bienhoa; banks of the river Be, *Pierre* 2834.

Excluded species.

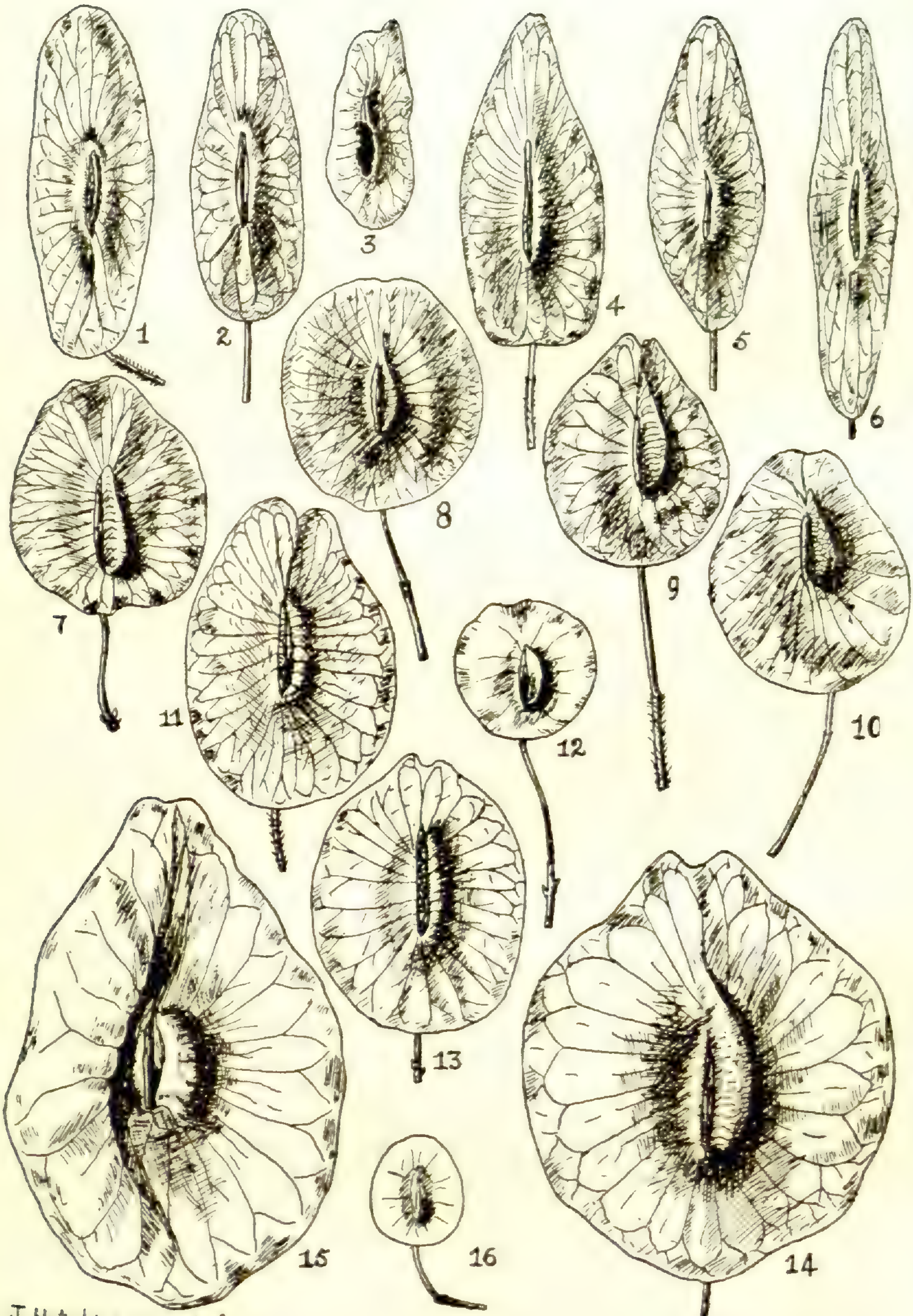
A. hypoglauca, Léveillé in Fedde, Repert. ix. 458 (1911) = **Tripterygium hypoglaucum,** *Hutchinson,* comb. nov. (*Celastraceae*).

Explanation of Figures on p. 103.

In order to bring out the shape of the fruits more clearly, only one winged carpel has been shown (there are usually 2 or 3) as they usually appear on a mounted sheet:—Fig. 1, *A. hirsuta;* 2, *A. Henryi;* 3, *A. Thorelii;* 4, *A. floribunda;* 5, *glabriuscula;* 6, *A. indica;* 7, *A. canarensis;* 8, *A. obcordata;* 9, *A. Helferiana;* 10, *A. concava;* 11, *A. Wallichii;* 12, *A. andamanica* (immature); 13, *A. nutans;* 14. *A. elliptica;* 15, *A. macrocarpa;* 16, *A. oxyphylla* (immature); all slightly below natural size; Nos. 3 and 15 are after Lecomte, and show the inner face of the carpel, the remainder original, showing the outside of the carpel.

Table showing the distribution of the species of *Aspidopterys*.

	Bombay and Mysore.	Madras.	N. W. India.	N. India and Bengal.	Assam and Bhotan.	Yunnan.	S. China.	Burma.	Moulmein and Tenasserim.	Andamans.	Siam.	French Indo-China.	Malay Peninsula.	Sumatra.	Java.	Borneo.	Philippines.
1. *hirsuta*								*			*						
2. *Henryi*						*											
3. *Thorelii*														*			
4. *floribunda* ...					*	*											
5. *indica*		*															
6. *glabriuscula* ...				*	*	*											
7. *canarensis* ...	*																
8. *obcordata* ...						*		*		*							
9. *Helferiana* ...									*								
10. *tomentosa* ...																*	
11. *Cavaleriei* ...							*										
12. *concava*								*				*	*		*	*	
13. *nitans*				*	*			*		*	*						
14. *oxyphylla* ...					*												
15. *andamanica* ...									*								
16. *elliptica*																*	*	*
17. *macrocarpa* ...											*						
18. *Esquirolii* ...							*										
19. *Wallichii* ...		*															
20. *Harmandiana* ...											*						
21. *cordata*	*																
22. *costulata* ...											*						



ASPIDOPTERYS.

XIV.—HEDYCHIUM CORONARIUM IN BRAZIL.

The following letter relating to *Hedychium coronarium* growing in a wild state in Brazil has been received by the Director from Mr. Clayton Beadle, who recently undertook the journey to Brazil in order to see the extent to which *Hedychium* has become established and also to investigate the possibilities of using it for paper-making in the country and elsewhere:—

Laboratories,
15, Boro', S.E.

March 5th, 1917.

Dear Sir,

I have recently returned from my visit to South America, which I undertook for the special purpose of investigating the growth of *Hedychium coronarium* [see *K.B.*, 1912, pp. 373-378].

I learnt on my arrival at Rio de Janeiro that *Hedychium* was to be found in the neighbourhood in small patches here and there and even near the town itself. I procured specimens which grew to a height of 10 or 12 feet. It is fairly well known in certain low-lying lands in the State of Rio, although not particularly abundant. Experiments made with a view to its cultivation in the State of Rio, particularly on land that has been cleared and used for sugar-cane, show very promising results, and this is a matter which is likely to be followed up in the State of Rio in the next few years. I was surprised to find very little *Hedychium* in the low-lying land at the back of Santos, because that land would appear, from its general character, to be particularly favourable to the growth of the plant. The district where *Hedychium* is particularly abundant is on the low-lying lands in the State of Parana, lying behind the ports of Antonina and Paranagua and stretching right away back from these ports to the mountains which rise precipitately to the plains where Curityba is situated. The most abundant supplies are centred round about Morretes, the old capital of Parana and stretch for miles in many directions. In this district, however, *Hedychium* grows not only on the plains about sea-level, but is to be seen in abundance along the railway line which winds up to Curityba up to an elevation of at least 1000 feet above sea-level. The size of the plant seems to diminish as one rises until it disappears altogether at an elevation of about 1500 feet. The normal height of the plant in the regions of the plains is about 5 feet. In certain favoured localities it reaches 10 and 12 feet, and is much bigger round in the stem. In such districts it is practically impossible to penetrate the dense growth. I was told that the flowering season was December or January. It appears to grow abundantly all the year round without any wintering; individual stems growing up and dying down in succession and throwing out new root-stocks. In places the ground underneath is more or less choked with the débris of dead stems. It seems to grow more vigorously after the ground is burnt over to clear it. If the undergrowth is burnt

off and even if stumps are left standing, *Hedychium* makes its appearance everywhere. This at first sight is difficult to account for, but on penetrating into the uncleared jungle one can see that *Hedychium* is already there waiting to make itself evident. I saw how it had taken possession of lands cleared for sugar-cane and how it had taken possession of any piece of cleared land. The next thing after clearing for sugar is to clear from *Hedychium*. It is quite evident therefore that in this district particularly the growth of *Hedychium* can be stimulated almost illimitably. The soil is rich, the rainfall heavy and the land is interspersed with small streams. It is not necessary that the land should be flat, in fact, it grows abundantly on slopes and on the sides of steep railway cuttings, etc.

On my way south I found it again at San Francisco, Parana. This is the next port below Paranagua, and likely in time to become an important port for Curityba. Here, again, stems were found up to 12 feet in length and in limited areas abundance of growth, which might well be extended by rough clearance.

I extracted the fibre from the green plant by mechanical means, imitating methods that would be employed for the preparation of the fibre for textile purposes, and came to the conclusion that a far whiter fibre may be extracted than has hitherto been employed by taking fairly simple precautions.

I visited various localities until we reached Rio Grande in the most southerly part of Brazil, also Uruguay, across the Argentine, up the Chilian and Peruvian Coasts, and finally came through the Panama Canal, and although I searched carefully I did not see any *Hedychium* after leaving the State of Parana.

I am communicating this information in the hopes that my observations may serve as an indication of the conditions under which *Hedychium* may be expected to flourish in those parts of the British Empire where favourable conditions prevail.

XV.—NIGERIAN FUNGI: III.

E. M. Wakefield.

The present contribution is the outcome of further collections made by Mr. C. O. Farquharson in South Nigeria during the period 1914–1916. The specimens were well chosen and in excellent condition; hence, besides adding a number of species to the Nigerian list the collection has supplied further valuable information with regard to some previously recorded forms. Six species new to science were obtained; two of these, *Polystictus pyrophilus* and *Geaster pulverulentus*, have already been described (*Kew Bull.* No. 3, 1916).

The only fungus in the list which is at present known to be of economic importance is *Ustulina zonata*, which was found by Mr. Farquharson in 1914 to be causing a distinct disease of Para rubber in Nigeria. It has since been fully described as a cause of rubber disease in the Federated Malay States.

Agaricaceae.

Lentinus velutinus, *Fr.* in Linnaea, 1830, p. 510.
Gambari Forest Reserve, No. 69.

These specimens were found growing out of the ground, but when dug out carefully each was found to arise from a small, smooth, more or less potato-shaped piece of wood, simulating a sclerotium. The wood is permeated by mycelium, and bounded externally by a thin dark layer, forming a delicate crust. The structure is exactly comparable with that described by Petch for the pseudosclerotia of *L. infundibuliformis* and *L. similis.* The pseudosclerotia in this case show evidence of injury by termites. The dark limiting layer is, however, continuous over the surface; hence it would appear either that this dark layer is formed after the wood has been partially eaten away by the white ants, or that the fungus mycelium is unpalatable to them and is left uninjured when the rest of the wood is destroyed.

Polyporaceae.

Polyporus pyrophilus, *Wakef.* in *Kew Bull.* 1916, p. 71.
On burnt ground, Nsulu-Aba District, Eastern Provinces. No. 50.

P. ostreaeformis, *Berk.* in Journ. Linn. Soc. xvi. 1877, p. 46.
Bonny, May, 1914; Opobo, May, 1914, No. 39.

This fungus is fairly common on wooden pier-piles along the sea front. It grows only a short distance above the surface of the water.

Amauroderma sericatum, *Lloyd.* Syn. Stipitate Polyp. 1912, p. 120.

On fragments of decaying wood sunk in the soil, Para rubber plantation, Economic Gardens, Calabar, No. 46.

Fomes yucatanensis (*Murr.*) *Sacc. et D. Sacc.* Syll. Fung. xvii. p. 116.

This species scarcely differs from *F. rimosus,* except in possessing setae in the hymenium.

F. pachyphloeus, *Pat.* in Journ. de Bot. iii. 1889, p. 257.
Gambari (Mamu) Forest Reserve, 1916, No. 73.

F. senex (*Nees et Mont.*) *Fr.* Nov. Symb. p. 62.
Gambari (Mamu) Forest Reserve, 1916, No. 72.

Both pileate and resupinate specimens were included in the one gathering.

F. albo-marginatus (*Zipp.*) *Cooke* in Grevillea, xiv. 1885, p. 19.

Polyporus albo-marginatus, Zipp. ex Lév. in Ann. sci. nat. sér. 3, vol. 2, 1844, p. 191, *P. Kermes,* Berk. et Br. in Journ. Linn. Soc. xiv. 1873, p. 49; *P. laeticolor,* Berk. in Journ. Linn. Soc. xvi. 1877, p. 46; *P. pyrrhocreas,* Cooke in Grevillea, xiv. 1885, p. 11.

This is the red-fleshed species which is common in the eastern Tropics, but the description given by Léveillé is poor and misleading. It does not appear to have been recorded previously for Africa.

Polystictus mutabilis (*Berk. et Curt.*) *Cooke* in Grevillea. xiv. 1885, p. 78.
Itu, Cross River, June, 1914, No. 45. On decaying wood in moist high forest.

P. versatilis (*Berk.*) *Fr.* Nov. Symb. p. 92.
On dead wood, under savannah conditions, Meko, No. 43.

P. vinosus (*Berk.*) *Sacc.* Syll. Fung. vi. p. 273.
Gambari (Mamu) Forest Reserve, 1916, No. 78.

P. caperatus (*Berk.*) *Fr.* Nov. Symb. p. 92.
Gambari (Mamu) Forest Reserve, 1916, No. 77.
The specimens are all thin forms, semi-resupinate and laterally confluent so as to form extensive patches. Similar forms have been received from Uganda.

P. tabacinus (*Mont.*) *Fr.* Nov. Symb. p. 93.
Itu, Cross River, June, 1914, No. 40. On decaying wood in moist high forest.

Poria calcea (*Berk. et Br.*) Cooke in Grevillea, xiv. 1886. p. 109. (Non *P. calcea* (Fr.) Bres. in Ann. Myc. vi. 1908, p. 41.)
Agege District, 1914, No. 54. Not uncommon under high forest conditions, where there is abundant moisture.

Trametes floccosa, *Bres.* in Ann. R. Ist. Bot. Roma, vi. 1896. p. 179.
Economic Gardens, Calabar, July, 1914, No. 51.
The pore-surface when fresh is white, but on drying it becomes slightly tinged with pink.

Hexagonia hirta (*Pal.*) *Fr.* Epicr. p. 496.
Bonny, May, 1914, on dead wood near the sea, No. 38.

H. Miquelii (*Mont.*) *Sacc.* Syll. vi. p. 361.
On dead mango branches, Economic Gardens, Calabar, July, 1914, No. 55.
These specimens are very pale, both pileus and pores being more or less alutaceous, instead of reddish. Like typically coloured specimens received from Uganda, they are perfectly smooth. Patouillard (Bull. Soc. Myc. Fr. xxx. p. 339) would refer all such forms to *H. bipindiensis*, but it is difficult to understand in what way they are distinct from *H. Miquelii*.

Merulius insignis, *Wakef.* sp. nov.

Pileus dimidiatus vel postice subdecurrens, ad 10 × 7 cm. expansus, mollis, azonatus, laete rubiginosus, in sicco rugulosus, 1-2 mm. crassus. *Tubuli* rubiginosi 0·5-0·75 mm. longi; *pori* concolori, irregulari, minuti, marginem versus deficientes. Margo sterilis albido-pallida. *Carne* albidum, tenue, molle. *Sporae* ellipticae, laete rubiginosae, 4-6 × 3-4 μ.

S. Nigeria. Gambari (Mamu) Forest Reserve; on wood, *C. O. Farquharson*, 1916.

The species is very conspicuous on account of the bright orange-brown colour of the pileus and pores, which corresponds to "Mars yellow" of Ridgway's Color Standards. Both in colour and in the spore characters it is close to *M. binominatus*, Massee. The latter however has less of a red tinge in the colour, differs in habit, and has larger and deeper pores.

THELEPHORACEAE.

Cladoderris spongiosus, *Fr.* Fung. Nat. p. 140.
Agege and Calabar, 1914, No. 47.
This plant occurs habitually on dead branches of Cacao in the wet season.

Stereum involutum, *Kl.* ex *Fr.* Epicr. p. 546.
Itu, June, 1914, No. 52; Gambari (Mamu) Forest Reserve, 1916, No. 82.

S. bicolor (*Pers.*) *Fr.* Epicr. p. 549.
Eket District, June, 1914.

Hymenochaete tristicula (*B. et Br.*) *Mass.* in Journ. Linn. Soc. xxvii. 1890, p. 111. *H. castanea*, Wakef. in *Kew Bull.*, 1914, p. 260. See also *Kew Bull.*, 1916, p. 73.
Gambari (Mamu) Forest Reserve, 1916, No. 83.
Apparently common in Tropical Africa.

Cyphella fulvo-disca, *Cooke et Mass.* in Grevillea, xviii. 1890, p. 5, and in Elliot, Hedwigia, 29, 1890, p. 67.
Agege, in the wet season, 1913, No. 53.

TREMELLACEAE.

Hirneola floccosa, *Wakef.* sp. nov.

Pileus imbricatus, sessilis, ad 11 cm. latus, postice subdecurrens, tomento fulvo molle e pilis longis 2·5–4·5 μ diametro dense floccoso-vestitus, azonatus, margine integro. *Hymenium* purpureo- vel castaneo-pruinosum, sub pruina nigricans. *Sporae* non visae. Hyphae sub-hymeniales et basales subgelatinosae, arcte conglomeratae, 5–7 μ diametro; hyphae centrales laxe intertextae, 1·5–2 μ diametro.

S. NIGERIA. Gambari Forest Reserve; on wood, *C. O. Farquharson*, 1916.

Distinct from all other known species of *Hirneola* in the soft, dense, woolly covering of the pileus. The long, lax, and slender hairs of which it is composed give it an appearance very different from that of the upper surface of, for instance, *H. polytricha*. The colour of the tomentum most nearly matches "Verona brown" of Ridgway.

The hymenium has a less gelatinous appearance than that of most species of the genus. Its colour lies between chocolate and Vandyke brown, with usually a more or less purplish cast.

GASTROMYCETACEAE.

Kalchbrennera corallocephala (*Welw. et Curr.*) *Kalchbr.* Phalloideae novi vel minus cognitae, 1880, p. 21. *K. Tuckii* (Kalchbr. et MacOw.), Berk. in Gard. Chron. v. 1876, p. 785.
Ibadan, 1916, No. 86.

Geaster pulverulentus, *Wakef.* in *Kew Bull.* No. 3, 1916, p. 73.
Agege, July, 1914, No. 58.

PYRENOMYCETACEAE.

Xylaria plebeja, *Ces.* Mycet. Born. 1879, p. 16.
On bush stumps. Para plantation, Agege, 1914, No. 64. A form with spores slightly smaller than in the type.

X. Thwaitesii, *Berk. et Cooke* in Grevillea, xii. 1883, p. 1.
On decaying wood in a shady situation, high forest, Agege, 1914, No. 65.

X. allantoidea, *Berk.* in Journ. Linn. Soc. x. 1869, p. 380.
In shady situation in high forest, Itu, 1914, No. 66.

Ustulina zonata (*Lév.*) *Sacc.* Syll. i. p. 352.
On diseased *Hevea brasiliensis*, Economic Gardens, Calabar, 1914, No. 68.

Hypoxylon suborbiculare, *Welw. et Curr.*, var. *Cookeanum*, Sacc. Syll. i. p. 399.
Very common on felled trees all over the Colony. Ibadan, 1914, No. 61.

Kretzschmaria paradoxa, *Pat.* in Bull. Soc. Myc. Fr. viii. 1892, p. 50.
On decaying Oil-Palm by river-side, Ibadan, 1914, No. 63.

K. coenopus (*Mont.*) *Sacc.* Syll. ix. p. 565.
On decaying wood in high forest, Agege, July, 1914, No. 62.

DISCOMYCETACEAE.

Cookeina Tricholoma (*Mont.*) *O. Kuntze* in Rev. Gen. pl. 2, 1891. p. 849.
On dead wood in high forest, Agege, July, 1914, No. 59.

C. sulcipes (*Berk.*) *O. Kuntze.* loc. cit.
For synonymy see Seaver in Mycologia v. 1913. p. 189.
Gambari (Mamu) Forest Reserve, 1916, No. 87.
Differs from *C. Tricholoma* in the broader spores, as well as in the fewer and shorter hairs on the margin of the cup.

Plicaria congregata, *Wakef.* sp. nov.

Ascomata subcupulata vel demum convexo-expansa, undulata, 0·5–1·5 cm diametro, extus verrucosa, brunnea, disco concolore. *Asci* cylindrici, breviter stipitati, octospori, 230 × 15–17 μ, pars sporifera circa 110 μ longa. *Paraphyses* hyalinae, simplices, sursum clavati, ad 6–8 μ lati. *Sporae* globosae, grosse verrucosae, pallide fuscescentes, 15–16 μ diametro. *Hypothecium* et excipulum pseudoparenchymaticum; hypothecii cellulae ad 80 diametro, excipuli minores. *Cellulae* exteriores brunneae, hinc inde in verrucas aggregatae.

S. NIGERIA. Gambari Forest Reserve; on burnt wood, *C. O. Farquharson*, 1916.
Differs from other species of *Plicaria* in the densely crowded habit.

Sarcosoma turbinatum, *Wakef.* sp. nov.
Ascomata sessilia vel substipitata, turbinata, 2–2·5 cm. diametro,

2·5–3 cm. alta, extus fuliginosa, pilis brunneis septatis apice obtusis 4–10 μ crassis vestita, intus subhyalino-gelatinosa. *Discus* planus. sordide flavidus, margine tumido cinctus. *Asci* cylindrici, circa 360 × 10–15 μ, pars sporifera circa 160 μ. *Paraphyses* hyalinae, filiformes, apice vix incrassatae, ascos superantes. *Sporae* hyalinae, ellipticae vel fusoideae, primo utrinque obtuse apiculatae, episporio maturitate minute granuloso, 28–30 × 12–15 μ.

S. Nigeria. Western Provinces: Shagamu; on wood, *C. O. Farquharson*, 1916.

This species somewhat resembles *S. camerunense*, P. Henn., but it differs in growing on wood, and in the hyaline, slightly rough spores. The spore-characters also distinguish it from other species with the same habitat, such as *Bulgaria Urnula*, Henn. and *S. javanicum*, Rehm.

Deuteromycetaceae.

Monilia carbonaria, *Cooke* in Grevillea, xv. 1886, p. 17.

Widely distributed throughout the Colony on all kinds of vegetable refuse, especially if charred.

This fungus appears to occur throughout the Tropics on burnt wood, etc. It was first described from New Zealand, on burnt branches, and has been received at Kew from Queensland, as well as from Nigeria. In the Malay States it appears to be common, but it has hitherto been recorded in Malay literature under the erroneous name of *Oospora gilva*, B. et Br., which is an entirely different plant.

Through the courtesy of Mr. F. T. Brooks I have examined the Malayan fungus, which he mentioned under the name of *Oospora gilva* in Bull. 21, Dept. of Agric., Fed. Malay States, p. 23, and which he informs me is so understood by Malayan mycologists generally. It proves to be specifically identical with the Nigerian fungus, and has no resemblance to *Oospora gilva*. The name *Oospora gilva* also appears in the Philippine lists, but whether a similar mistake has been made there I am unable to say, as I have seen no Philippine specimens.

Furthermore, the same fungus or one very closely allied to it occurs in Brazil, and is described by Möller in Schimper's Botanische Mittellungen, Heft 9, Phycomyceten und Ascomyceten, p. 75 et seq.

Möller connected the Brazilian fungus with an ascigerous stage, which he called *Melanospora erythraea*. No ascigerous form has as yet been identified as belonging to *Monilia carbonaria*. Möller also states that the fungus is most common in the wet season, whereas the contrary is the case in Nigeria. It cannot therefore be assumed that the species are identical, but they are obviously very close.*

* Since the above was written a collection of slides brought home by Mr. A. Sharples, Mycologist to the Department of Agriculture, Federated Malay States, has been examined. Amongst these was one labelled "Perithecia from a culture of *Oospora gilva*." The asci and spores in this slide agree well in general characters with those described by Möller for *Melanospora erythraea*. It is not possible to say whether any of the asci contained only four spores, but the spore size agrees with that of the smaller spores of *M. erythraea*, none being as large as 36 × 16 μ. The variations observed are 20–27 × 10–14 μ. The shape of asci and spores, and the longitudinal striations of the spore membrane, are the same as described by Möller (l.c. p. 76). It seems certain that *Melanospora erythraea* is a widely distributed fungus in the Tropics, but the perfect stage has so far only been obtained in culture.

Mr. Farquharson has supplied the following notes with regard to the growth of the fungus in Nigeria.

"This fungus is widely distributed throughout the colony and most probably along the West African coast. It is perhaps the most characteristic and the most striking form to be seen in the dry season when the natives fire the bush clearings in the making of their farms. During the dry season (November to March at Ibadan) rain falls but seldom, but not infrequently the nights are marked by heavy dews. when the night temperature may fall rather low, to 60 F.° or even less.

"The fungus flora of burnt wood is not very extensive, but this form seems to have specialised in this direction. The charred wood, one might almost say, has hardly had time to cool, when the bright orange-pink spore-masses of the fungus begin to make their appearance. These spore-masses are large enough to be visible at a considerable distance. My own first acquaintance with it was when I saw it from the train as we went up country on my first arrival in the colony. The moisture requirement of the fungus must be extremely small, and the rapidity of its appearance on a freshly burnt substratum is quite extraordinary.

"It is seen with far less frequency in the wet season. but is common on cast-away corn cobs from which the corn has been eaten. It proved a nuisance one season on bags of ground cassava. All kinds of plantation trash, especially if charred, afford suitable substrata."

The fungus is remarkable for the varying size and form of the conidia, and for the ease with which the hyphae break up into their constituent cells. At maturity it consists of a loose powdery mass of conidia and hyphal segments, varying in diameter from 5 μ to 20 μ. It is not a typical *Monilia*, but the branched hyphae place it in this genus rather than in *Oospora*.

XVI.—NOTES ON AFRICAN COMPOSITAE: IV.

J. Hutchinson.

Matricaria, *Linn.*, and **Chrysanthemum,** *DC.*

In a previous contribution* the necessity for a change in our conception of the genera *Pentzia* and *Matricaria*. based chiefly on their probable phyletic development in response to the peculiar climatic conditions in South Africa, has been shown ; and the discoid species of *Matricaria* were accordingly transferred to *Pentzia*. It is suggested that *Pentzia* as thus defined has arisen directly from *Matricaria*. The entire suppression of ray-flowers, the usually shrubby habit, and the highly xerophytic type of leaf of the majority of the species of *Pentzia*, seem to point strongly in support of this hypothesis. A continuation of this line of descent may be clearly traced onwards to the considerable South African genus *Athanasia*, through the remarkably close relationship of *Pentzia pinnatifida* Harv., and *Athanasia acerosa*, Harv. The occurrence at the Cape of *Matricaria*. an otherwise entirely boreal genus, with only a single representative in Tropical Africa, and that not farther north than the Zambesi delta, suggests that the South

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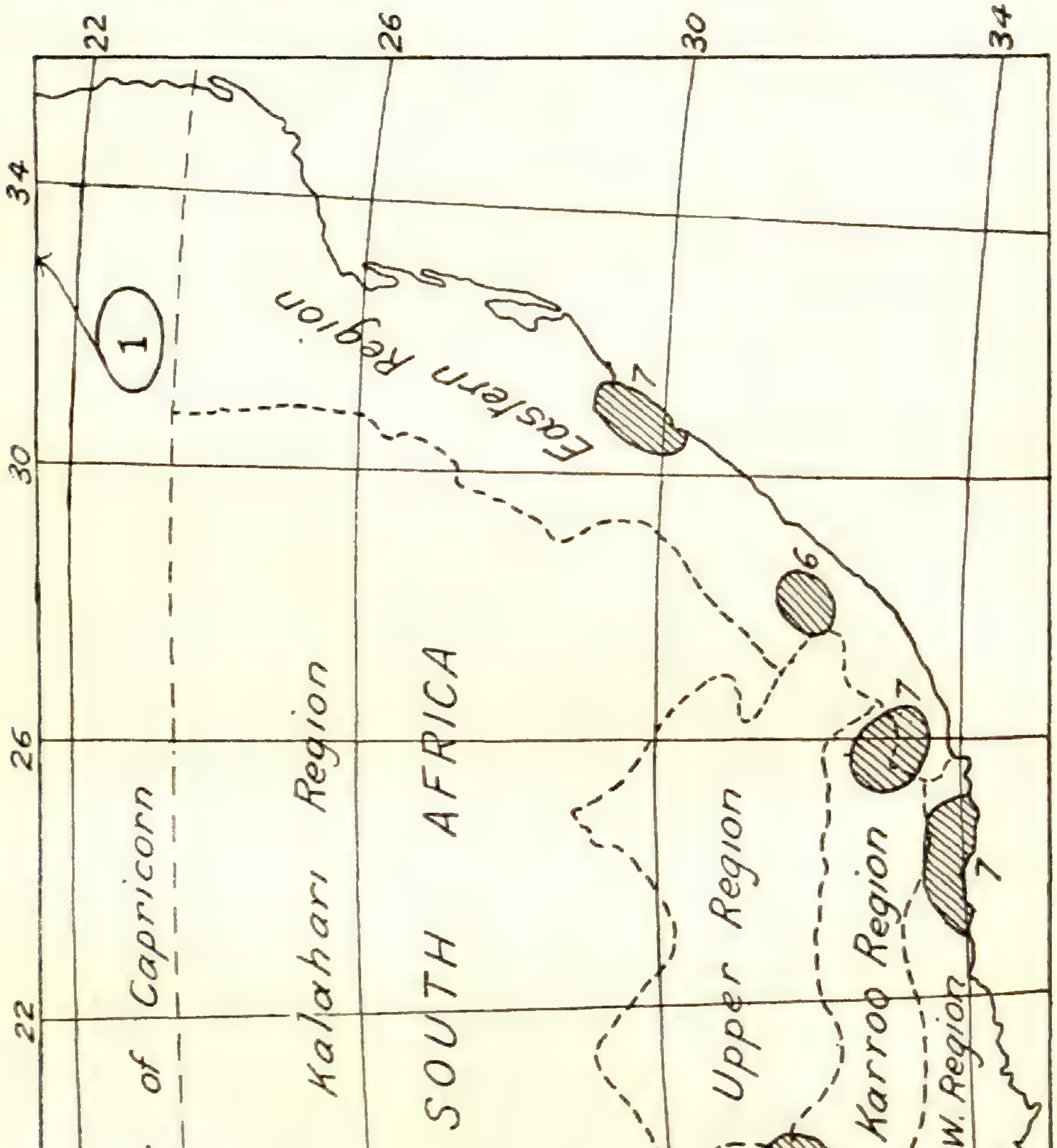
* *Kew Bull.*, 1916, 241.



Sketch map (after Bolus) showing distribution of *Matricaria* in South Africa: 1, *M. hispida* (in Zambesi Delta); 2, *M. glabrata*; 3, *M. capensis*; 4, *M. hirta*; 5, *M. tenella*; 6, *M. zuurbergensis*; 7, *M. nigellaefolia*.

African Matricarias are relics of the temperate flora of that vast antarctic continent now vanished, where the genus was probably as strongly represented as it is in the Northern Hemisphere at the present day. At the Cape all the species are endemic, and are remarkably local in their distribution (see map), a fact which seems to confirm the view that they are isolated relics and have not directly descended from their boreal relatives, for so far as we know, no species has as yet been gathered on those lofty East African mountains which have a few representative species of certain genera otherwise confined to the northern hemisphere. (See Engler in Ann. Bot. xviii. 523-540.)

The accompanying map shows the distribution of *Matricaria* in South Africa.

Matricaria, *Linn.*

Clavis specierum.

Achaenia minute vel distincte papposa :—
- Pappus minutissime setulosus ; plantae ubique lanato-pilosae ; species zambesiaca ... ... 1. *hispida.*
- Pappus oblique cupularis vel truncatus ; plantae plerumque glabrae vel glabrescentes ; species austro-africanae :—
  - Achaenia pappo obliquo uno latere fisso dentato coronata ; caules erecti :—
    - Folia simpliciter pinnatisecta ; receptaculum ellipsoideum ... ... 2. *glabrata.*
    - Folia plerumque bipinnatisecta ; receptaculum subglobosum ... ... 3. *capensis.*
    - Folia plerumque bipinnatipartita, "asperate hispida," receptaculum ovato-conicum ... 4. *hirta.*
  - Achaenia pappo truncato integro coronata ; caules debiles et plerumque errabundi ; pedunculi longissimi, nudi ... ... 5. *tenella.*

Achaenia epapposa :—
- Flores radii circiter 1 cm. longi, conspicui ; caulis elongatus, laxe ramosus, internodiis 4-5 cm. longis ; folia bipinnatisecta, segmentis lanceolatis acutissimis ... ... 6. *zuurbergensis.*
- Flores radii inconspicui, infra 0·5 cm. longi :—
  - Capitula circiter 1 cm. diametro ... ... 7. *nigellaefolia.*
  - Capitula circiter 0·5 cm. diametro ... ... 7. *nigellaefolia, var. tenuior.*

1. **M. hispida,** *Vatke* in Oestr. Bot. Zeitschr. xxvii. 194 (1877) ; Oliv. et Hiern in Oliv. Fl. Trop. Afr. iii. 397.

Tropical Africa.—Portuguese East Africa : wet places near Sena, Zambesi, *Hildebrandt ; Peters ;* Zambesi delta between Mambusha and Vicénte, Sept., *Scott ;* open woods at Beira, Dec., *Swynnerton*, 1872.

I have not seen the type specimen collected by Hildebrandt, but there seems little doubt that Scott's and Swynnerton's plants belong to this species, judging from Vatke's description.

2. **M. glabrata,** *DC.* Prodr. vi. 51 (1837) ; Harv. in Harv. et Sond. Fl. Cap. iii. 165.

Chrysanthemum glabratum, Thunb. Fl. Cap. ed. Schult. 693 (1823). *Pyrethrum glabratum*, Less. Synop. Comp. 254 (1832).

South Africa.—S.W. Region: Piquetberg; near Groene Vallei, below 320 m., Oct., *Drège*. 'S. Africa,' *Thunberg* (type).

3. **M. capensis,** *Linn.* Mant. 115 (1767); Thunb. Fl. Cap. ed. Schult. 693; DC. Prodr. vi. 50; Harv. in Harv. et Sond. Fl. Cap. iii. 164; Bolus et Wolley-Dod in Trans. S. Afr. Phil. Soc. xiv. 282.

Cotula capensis, Linn. Sp. Pl. 287 (1763).

Matricaria africana, Berg. Pl. Cap. 296 (1767).

M. pusilla, Willd. Enum. ii. 907 (1809); Poir. Dict. Suppl. iii. 605; DC. Prodr. vi. 52 (fide J. Gay).

South Africa.—S.W. Region: Cape; Vaarsche Vley, Nov., *Wolley-Dod* 3646. 'S. Africa,' *Pappe*; *Hort. Gouan.*—Cultivated in Jardin des Plantes, Paris, in 1835 (Herb. *Gay*).

According to Bolus and Wolley-Dod (l.c.), this species is rare; it grows in sandy places and hillocks in Vaarsche Vley on the Cape Peninsula.

4. **M. hirta,** *DC.* Prodr. vi. 51 (1837); Harv. in Harv. et Sond. Fl. Cap. iii. 165; Bolus et Wolley-Dod in Trans. S. Afr. Phil. Soc. xiv. 282.

Chrysanthemum hirtum, Thunb. Fl. Cap. ed. Schult. 693 (1823) *Pyrethrum hirtum*, Less. Synop. Comp. 254 (1832).

South Africa.—S.W. Region: Cape; wet depressions near Cape Town, *Thunberg* (type); marshes near the Salt River, Cape Flats, *Harvey*.

I have not seen an example of this species; it was not found on the Cape Peninsula by Bolus and Wolley-Dod, who doubt its distinctness from *M. capensis*.

5. **M. tenella,** *DC.* Prodr. vi. 51 (1837); Drège, Zwei Pflanzengeogr. Docum. 107, 109; Harv. in Harv. et Sond. Fl. Cap. iii. 165.

M. tenella, var. *multicaulis*, Drège Herb.

South Africa.—S.W. Region: Vanrhynsdorp; Ebenezer, sandy heights below 160 m., Nov., *Drège*; Zout River, 145 m., Aug., *Schlechter* 8114. Clanwilliam; Lange Valley, below 330 m., July, *Drège* b; fields near Clanwilliam, Oct., *Bolus* 9028; *Schlechter* 8012. Upper Region: Calvinia; Nieuwoudtville, *Leipoldt in Herb. Bolus* 9389. 'S. Africa,' *Zeyher* 829.

6. **M. zuurbergensis,** *Oliv.* in Hook. Ic. Plant. t. 2230 (1892).

South Africa.—Eastern Region: in woods at Malowe and on the Zuurbergen, 1300 m., Mar., *Tyson* 2768 (Herb. Norm. 1064); in shady bush on the Zuurberg, *Wood* 3046.

7. **M. nigellaefolia,** *DC.* Prodr. vi. 50 (1837); Drège, Zwei Pflanzengeogr. Docum. 130, 140; Harv. in Harv. et Sond. Fl. Cap. iii. 164.

South Africa.—S.W. Region: Knysna; Wittedrift and Plettenbergs Bay, *Pappe*. Uitenhage: between Coega River and Sunday River, chalk flats below 320 m., Dec., *Drège*. Karroo Region: Somerset; by the Great Fish River at Van Aardt's, June, *Burchell*

3255; 3248. Eastern Region: Albany; Zwartwater Poort, on the rocks, July, *Burchell* 3357; moist valleys near Grahamstown, Nov., *MacOwan* 557; King Williamstown; Kei Road, 620 m., Dec., *Schlechter* 6136; Natal; Inanda, *Medley Wood* 624 ("aquatic"); Mt. Moreland, Nov., *Medley Wood* 1387; without definite locality, *Gerrard* 566; *Saunders*.—Cultivated at Kew in 1861, at the Jardin des Plantes, Paris, in 1839 (Herb. *Gay*), and at Chelsea in 1852 (Herb. *Thos. Moore*).

Var. **tenuior,** *DC.* l.c.; Harv. l.c.

South Africa.—Eastern Region: Albany; near Grahamstown, Feb., *Baur* 1059; Dec., *Drège*. Natal; near Curry's Post, 1300 m., Dec., *Medley Wood* 3600; without definite locality, *Cooper* 1146.

Species excludenda.

Matricaria pinnatifida, Klatt in Bull. Herb. Boiss. iii. 437 (1895)= **Anisopappus pinnatifida,** *O. Hoffm.* MSS. in Herb. Zurich.

I am much indebted to Dr. Hans Schinz for examining the type specimen and acquainting me with this new combination.

Chrysanthemum, *DC.*

The genus *Chrysanthemum*, as defined by Bentham and Hooker, is distributed throughout Europe, Temperate Asia, North Africa and Orient, and Arctic America. It embraces about 130 species; a few such as *C. segetum*, L., *C. Parthenium*, Pers., and *C. leucanthemum*, L., being widely dispersed weeds of cultivation. The species, mostly indigenous to the areas mentioned, are distributed as follows:—Europe, 45; Canaries and Madeira, 16; North Africa, 21; Orient, 14; Himalaya, 3; North Asia, 18; China and Japan, 13; Arctic America, 1; South Africa, 5. Here again, as in the case of *Matricaria*, there is a big gap in distribution, the bulk of the genus occurring in the Northern Hemisphere, with a few endemic species at the Cape. The nearest related species to the South African, and they are also nearest geographically, are those of the Canary Islands, where they are of a similar shrubby habit. Eventually, no doubt, as these interesting facts accumulate, some light may be thrown on the origin and affinities of the Cape *Compositae*.

Clavis Specierum.

Pappus bene evolutus, corollae tubo equilongus vel fere aequilongus:—

Pedunculi elongati, nudi, 5–15 cm. longi:—

Folia basi tumida, non decurrentia, lobis longis et gracilibus ascendentibus acutis 2–4 cm. longis	1. *nodosum.*
Folia basi ?, lobis brevissimis dentiformibus patulis subacutis; species mihi ignota ...	2. *Thunbergii.*
Folia integra, decurrentia, basi non tumida ...	3. *decurrens.*

Pedunculi breves et foliacei, parte nuda vix 1·5 cm. longa:—

Folia omnia vel fere omnia apice breviter trilobata, 0·5 cm. longa	4. *carnosulum.*
Folia omnia vel plerumque integra, uncinata 1 cm. longa	4. *carnosulum*, var. *filifolium.*

Pappus minutus vel nullus :—

Capitula solitaria, caules vel ramos simplices vel subsimplices terminantia ; folia dentata vel lobulata :—

Rhizoma vel radix basi non lanata ; species introductae :—

Plantae annuae ; folia plerumque lobulata ; flores radii flavi ... ... 5. *segetum.*

Plantae perennes ; folia obtuse dentata ; flores radii albi ... ... 6. *leucanthemum.*

Rhizoma basi dense lanatum ; folia argute serrata, acuta... ... ... 7. *osmitoides.*

Capitula densiuscule corymbosa ; folia bipinnatipartita ; species introducta ... ... 8. *Parthenium.*

1. **C. nodosum,** *DC.* Prodr. vi. 65 (1837) ; Harv. in Harv. et Sond. Fl. Cap. iii. 162.

Arctotis nodosa, Thunb. Fl. Cap. ed. Schult. 711 (1823).

Pinardia nodosa, Less. in Linn. 1831, 169. *Ismelia nodosa,* Less. Synop. Composit. 255 (1832).

Chrysanthemum leptophyllum, var. *indivisum,* Drège, Zwei Pflanzengeogr. Docum. 95 ; var. *trisetum,* Drège l.c. 108.

South Africa.—South-Western Region : Vanrhynsdorp ; Ebenezer, on stony dry " karroo-like " hills, below 160 m., Nov., *Drège* var. *a.* a ; Windhoek, 230 m., Aug., *Schlechter* 8353. Clanwilliam ; between Lange Valley and Heerenlogement, below 160 m., July, *Drège a, b.* Western Region : Little Namaqualand ; between Zwart Doorn River and Groen River, below 1000 ft., Aug., *Drège, β.* a. Kalahari Region : Calvinia ; Bitterfontein, hills, Sept., *Schlechter* 11034.

2. **C. Thunbergii,** *Harv.* in Harv. et Sond. Fl. Cap. iii. 162 (1865).

Chrysanthemum frutescens, Thunb. Fl. Cap. ed. Schult. 693 (non Linn., quoad plantam Canariensis).

Pyrethrum frutescens, Thunb. ex Harv. l.c. nomen.

Ismelia frutescens, Less. Synop. Comp. 255 (1832).

Pinardia frutescens, Less. in Linnaea 1831, 169.

South Africa.—Without definite locality, *Thunberg.*
Species not seen by the writer ; the type is only in Herb. Thunberg.

3. **C. decurrens,** *Hutchinson,* sp. nov.

Planta carnosa, usque ad 20 cm. alta ; ramuli ascendentes, glabri. *Folia* basi decurrentia, linearia, apice obtuse callosa, 3–4 cm. longa, circiter 1·5 mm. lata, integra, glabra. *Capitula* solitaria, longe pedunculata, circiter 1–1·4 cm. diametro ; pedunculi nudi, usque ad 12 cm. longi, glabri. *Involucrum* late campanulatum ; bracteae 3–4 seriatae, exteriores oblongo-ovatae, apice rotundatae, intermediae et interiores obovato-rotundatae, 3–4 mm. longae, 2–3 mm. latae, margine membranaceae, glabrae. *Flores radii* brevissimi, ligulati ; corollae tubus 1·5 mm. longus, glaber, limbo brevissime cuneato-spathulato truncato

minute crenulato 4-nervio. *Flores disci* : corollae tubus 1 mm. longus, lobis triangularibus subacutis marginibus incrassatis ; antherae conspicue appendiculatae, apice glandulo flavo coronatae. *Achaenia* compressa, pilis densis mucilaginosis albis marginata. *Pappi* squamae 3 vel 4, imbricatae, orbiculares, 1·5 mm. diametro, siccae et membranaceae.

South Africa.—Western Region : Little Namaqualand ; in dry places between Port Nolloth and Oograbies, about 100 m., Aug., *Bolus* 9571.

This is a very marked new species with fleshy stems and leaves, the latter decurrent on the shoots.

4. **C. carnosulum,** *DC.* Prodr. vi. 65 (1837) ; Harv. in Harv. et Sond. Fl. Cap. iii. 162.

Pyrethrum frutescens, Thunb. partly ex Harv. l.c., nomen. *Pentzia frutescens*, Fenzl ex Harv. l.c., nomen.

South Africa.—South-Western Region : Bredasdorp ; Zeekoevley, 30 m., Apr., *Schlechter* 10539. Swellendam ; between Rietkiul and Hemel en Aarde, on the Kenko River, below 320 m., *Zeyher* 2831. Riversdale ; hills near Zoetemelks River, Nov., *Burchell* 6741 ; between Great Valsch River and Zoetemelks River, Nov., *Burchell* 6578 ; Gauritz River, *Pappe*.

Var. **filifolium,** *Harv.* l.c. 163.

South-Western Region : Caledon ; in open places near Springs, Apr., 280 m., *Bolus* 7464 ; Bot River, 340 m., Apr., *Schlechter* 7591. Swellendam ; hills between Swellendam and Breede River, shrub 2 ft. high, Jan., *Burchell* 7450 ; on dry hills near Breede River, Jan., *Burchell* 7461 ; near Swellendam, Dec., *Pappe* [type of var.]. Karroo Region : Ceres ; Klyn Vley, Cold Bokkeveld, 1420 m., Jan., *Schlechter* 10216.

This is usually a well-marked variety, which is, however, scarcely deserving of specific rank ; the leaves are longer and more slender than in the typical form and they are nearly always entire and uncinate at the tip. In Schlechter's specimen from Ceres (no. 10216) the leaves are both entire and divided on the same shoot, and there is also a note to this effect by Harvey regarding Pappe's specimen in Herb. Dublin, which is the type of the variety.

5. **C. segetum,** *Linn.* Sp. Plant. 1254 (1763) ; DC. Prodr. vi. 64 ; English Botany, t. 540, Harv. in Harv. et Sond. Fl. Cap. iii. 162 ; Bolus & Wolley-Dod in Trans. S. Afr. Phil. Soc. xiv. 282.

South Africa.—The common "Corn Marigold," introduced from Europe.

6. **C. leucanthemum,** *Linn.* Sp. Pl. 888 (1763).

South Africa.—Eastern Region : East Griqualand ; in meadows near Kokstad, 1600 m., Feb., *Tyson* 1705. Natal ; Van Reenen, 1600–2000 m., Jan., *Wood* 9009.

The common "Dog-Daisy," introduced from Europe.

7. **C. osmitoides,** *Harv.* Thes. Cap. ii. 33, t. 152 (1863) ; Harv. in Harv. et Sond. Fl. Cap. iii. 163.

South Africa.—Eastern Region : Natal ; Omgati, *Gerrard* 1026. Kalahari Region : Transvaal ; hills above Barberton, 1320 m., Oct., ray fls. white, disk yellow, *Thorncroft in Herb. Wood* 5729 ; grassy mountain slopes of the Saddleback Range, Barberton, 1100–1480 m., Nov., " heads cream colour," *Galpin* 685.

8. **C. Parthenium,** *Pers.* Synop. ii. 462 (1807).

South Africa.—Without definite locality, *Harvey*. A common garden plant, introduced.

XVII.—SEED SELECTION IN THE CULTIVATION OF HEVEA BRASILIENSIS.

The following letter from Mr. F. A. Stockdale, Director of Agriculture, Ceylon, has been received by the Director with a note on seed selection of *Hevea* in Ceylon, which has been drawn up by Mr. T. Petch, Botanist and Mycologist to the Department of Agriculture.

Department of Agriculture,
Peradeniya, Ceylon,
26th May, 1917.

Sir,

1. With reference to the article on Seed Selection in the Cultivation of *Hevea brasiliensis* by Messrs. Clayton Beadle and Henry P. Stevens. I have the honour to forward for publication the enclosed brief note which has been prepared, at my request, by Mr. T. Petch, Botanist and Mycologist of this Department.

2. This gives a brief account of the attempts made by this Department in Ceylon in regard to seed selection of *Hevea*. The whole research has only been limited by the want of men and money and will, I hope, after the war, be extended—possibly with the help of the Rubber Growers' Association.

3. This account refutes statements by Messrs. Clayton Beadle and Henry P. Stevens and by Mr. Marsden as to inaction in the matter of seed selection—statements which would not have been made had they been in touch with the work being carried out by this Department in Ceylon.

I am, Sir,

Your obedient Servant,

F. A. Stockdale,
Director of Agriculture.

The Director,
Royal Botanic Gardens,
Kew.

Seed Selection in Hevea.

The question of seed selection in *Hevea* was a subject of discussion at the Ceylon Rubber Exhibition in September, 1906, and one of the deciding factors in the appointment of the late Dr. R. H. Lock as Assistant Director of the Royal Botanic Gardens, Ceylon, a year later, was his recognised standing as an authority on plant breeding.

Systematic experiments on rubber-tapping were begun in 1908 on the old trees at Heneratgoda, then the only tappable trees under the control of the Botanic Gardens, and when it had been established that Tree No. 2 at Heneratgoda steadily yielded an amount of rubber far in excess of any of the other trees in tapping, steps were taken to plant up an area with seed of that tree. There are now three acres of *Hevea* on the Experiment Station, Peradeniya, planted with that strain. The oldest (2 acres) was planted in 1912, with stumps one year old, and is not yet tappable. The intention at present is that when these trees are fit for tapping they will be tapped to determine which of them are good yielders ; the poor yielders will then be cut out, and the area reserved for seed. It is of course recognised that investigations on the subject of the inheritance of latex capacity may compel modifications of the scheme.

Other experiments at Heneratgoda have yielded a mass of data, which, owing to the reduction of the scientific staff, has not yet been analysed. For example, an experiment was begun in 1908 on seventy trees tapped at different (time) intervals, in groups of ten. Through the removal of a shelter belt, several of these were blown down in 1913, but there still remain some fifty trees whose individual latex yield has been recorded for every tapping since June, 1908, the trees having been tapped continuously at regular intervals, varying in the different groups from one to seven days. And there is a large number of trees whose individual latex or rubber yield has been recorded for periods of one to two years. It is, therefore, scarcely correct to state that no attempt has been made to obtain reliable data as to the variation in yield of latex and rubber from individual trees.

In 1912, an attempt was made to attack the problem from another side, viz., to determine whether the latex-yielding quality can be associated with any definite botanical character, and to what extent such characters are transmitted.

On this subject, the individual planter generally has very definite views, but few agree with one another. In Ceylon, three types of bark are usually distinguished, smooth, moderately corky, and very corky. The smooth-barked tree is often regarded as a poor yielder, and this appears to be true, if the smooth exterior is associated with a yellowish and somewhat granular internal structure. But there is some evidence that the external appearance of the trees, in Ceylon, varies with the elevation of the plantation. Differences in the foliage have also been associated with latex yield, the small-leaved tree being regarded as a poorer yielder than the large-leaved form. On the other hand, the large-leaved tree appears to suffer more from the leaf-fall caused by *Phytophthora* than the small-leaved, though it remains to be determined whether this is merely due to the fact that the loss of the same number of leaves makes a greater difference in the appearance of the tree in the former. There is also a tree with a dark glossy leaf which contrasts strongly with the normal leaf, a fact which may prove of service in the matter of disease resistance. With regard to the colour of the bark, it was stated in Ceylon some ten years ago that trees with a pink bark were poor yielders. On examination it was found that the pink external coloration was due to the presence of a red alga (*Chroolepidae*), which finds a better footing on smooth than on rough-barked trees. This accords with the late Dr. Huber's statement that

the difference between the white and black *Hevea* of the Amazon is due merely to the growth on the stem of different species of lichens, according to the exposure of the tree.

Seeds were selected in 1912 from trees which showed well-marked characters, seed and leaf characters being chosen as a beginning. The experiment however was regarded as a purely scientific fad, and the subsequent treatment of the plants was such that it has small prospect of result. A large number of trees is required, before any definite conclusions can be based on such experiments, and this necessitates the occupation of an acreage which at the present time is not available.

A small experiment which may afford preliminary ideas on the relation of yield to botanical characters has been in progress for nearly a year. Twenty trees of the same age, growing in a four-acre block at the Experiment Station, Peradeniya, have been selected for differences in leaf or bark characters. These are all tapped on the same system, and the yield of rubber from each tree is recorded separately for every tapping.

Reference may also be made to the investigations on *Hevea* cortex by Messrs. Bryce and Campbell which were designed ultimately to discover whether any relation existed between structure and yield. Preliminary bulletins have been issued, but the work has now lapsed owing to the departure of both these officers on military service.

The problem of seed selection in *Hevea* has been attacked by the Ceylon Department of Agriculture from both the empirical and the scientific standpoint, but it is not possible to attain results rapidly, and the rate of progress is necessarily governed by the money and men available for the work. T. Petch.

XVIII.—MISCELLANEOUS NOTE.

Plant Diseases in Queensland.—*The Diseases in Plants Act* of 1916 which has recently been introduced in Queensland provides measures with regard to the introduction and eradication of diseases in that country. The Act came into operation on January 1st, 1917.

Every insect, fungus, and plant introduced into Queensland or removed from any nursery or orchard contrary to the Act, and every diseased plant or infected package introduced into Queensland or removed from one part of the State to another may be forthwith seized by an inspector and dealt with by destruction or otherwise as the Minister or inspector may direct. Under penalty of a fine every orchard and nursery must be registered on or before March 31st each year. Two schedules under the Act provide respectively for the "Nursery" return (area of nursery) and the "Orchard" return (number of acres of bananas, pine-apples and number of fruit trees).

Except in the case of injury and destruction of non-diseased plants, persons are not entitled to any compensation in consequence of any measure taken for the eradication of the disease or the destruction of any insect, fungus, or diseased plant. Persons guilty of an offence against the Act are liable to a penalty not exceeding £20.

That Queensland intends to take strict precautions against the introduction and spread of diseases is evident from the details of the Act, and especially from the schedules regarding the registration of orchards and nurseries. A. D. C.

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ROYAL BOTANIC GARDENS, KEW.

BULLETIN

OF

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Nos. 4 & 5] [1917

XIX.—THE GENUS STRYCHNOS IN INDIA AND THE EAST.

A. W. Hill.

Owing to the difficulty of arriving at a satisfactory determination of some specimens of *Strychnos* sent to Kew from the Philippine Islands and from Amboina it seemed advisable to re-examine the plants from Malaya generally, and this led finally to a general revision of the genus in India and throughout the East. As a result twenty-two new species and some new varieties have been described. Two species usually regarded as synonyms have been restored and one species has been excluded.

Of the new species three are not very perfectly known, but are sufficiently distinct to justify a description being drawn up.

The present account is far from exhausting our knowledge of the genus in the East, as there is good evidence of several species in Siam, Cochin-China, Borneo, the Philippine Islands, etc., which are represented in herbaria by leaf specimens only, and have not yet been described. Ninety-three species of *Strychnos* have now been described from India and the East by various authors, but as one of these is excluded in the present account the actual number of well-authenticated species in this region is really ninety-two, and of these seventy-eight are represented in herbaria by good and fairly complete specimens.

Our knowledge of these Eastern species has grown somewhat rapidly. De Candolle, in the Prodromus, gives descriptions of eleven species, two being imperfectly known; Bentham, in his account of the *Loganiaceae*, describes fourteen species of *Strychnos*, but suppresses three of those given by De Candolle, and C. B. Clarke in Hooker's "Flora of British India" gives descriptions of nineteen species for India, Ceylon and Malacca, suppressing one of those included in the Prodromus.

In 1907, King and Gamble in "Materials for the Flora of the Malayan Peninsula" describe eleven species, a number which has been increased to fourteen for the peninsula alone in the present enumeration. (*S. pseudo-tieuté*, A. W. Hill, described in *K.B.* 1911, p. 287 is now included under *S. ovalifolia*, Wall. under which species *S. Beccarii*, Gilg, from Borneo, has also been placed.)

Borneo, no doubt, is rich in species of *Strychnos*, but at

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present only five have been identified with any degree of certainty, and three of these also occur in Malaya. From Java and Sumatra six species have been described: one of these is the well-known *S. Tieuté*, which is related to *S. ovalifolia*; *S. monosperma* from Java is imperfectly known, and of the other four, two occur in each island and form two pairs of closely related or representative species.

The Malayan region therefore, including Borneo, Java and Sumatra, is the home of some twenty-two different species of the genus, none of which is found outside that area.

In the *Kew Bulletin*, 1909, pp. 359, 360, four new species of *Strychnos* were described, two being from New Guinea, and the number now known from that island has been raised to eleven, of which eight have recently been collected by Schlechter and by Ledermann, and in addition there is the imperfectly known species *S. Kerstingii*, described in 1901 by Gilg and K. Schum. This latter was the first *Strychnos* to be recorded from the island. One of the New Guinea plants occurs also in Amboina, and a new species is described from that island in the present paper. From the Philippine Islands, *S. multiflora*, Benth., was for many years the only well-authenticated species, though *S. Ignatii*, whose peculiar seeds rich in strychnine had long been an article of commerce, was known to be a native of the islands. Now, thanks to the efforts of Messrs. Elmer and Merrill in particular, thirteen species have been described from the Archipelago, and doubtless there are several others of which we only possess imperfect specimens. From the Celebes, also, there are imperfect specimens preserved in our herbaria.

Both for Ceylon and Southern India two new endemic species are described in the present revision and an interesting new tree species *S. Nux-blanda*, allied to *S. Nux-vomica*, has been identified as the typical species throughout Burma to Siam and French Indo-China.

The genus is richly represented in Siam and Cochin-China, and there appear to be many imperfectly known species. We owe to Pierre the discovery of some seven new species in Cochin-China, and Dop enumerates thirteen species from the French possessions in Indo-China. In the present account the number of species from Cochin-China is fifteen, four new species being described, for it has been found that Dop was incorrect in assigning two plants to the Malayan species *S. Ridleyi* and *S. pubescens*, and was really dealing with two undescribed species, and also that under *S. Gautheriana* three different species were included.

From Siam we now know five species, and the species from this region as would be expected form a connecting link between those from Burma and those from the French Colonies.

In addition to the countries already mentioned there are the Andaman Islands, with at least two endemic species, one being related to the Tenasserim species *S. hypogyna*, the other to *S. cinnamomifolia* from Ceylon. The Island of Narcondam has also a peculiar species, imperfectly known, whose affinities appear to be with Tenasserim. Two endemic species long

known from Hongkong; an imperfectly known species from Formosa, an endemic species in the Fiji Islands and four in Australia, including a new tree species now described for the first time, complete the enumeration.

Classification.

For purposes of classification the Indian and Eastern species may be arranged in four groups or sections, two of which appear certainly to be natural subdivisions of the genus.

The first section (**Brevitubae**) is distinguished by the very short corolla tube, so much so that in some species the corolla appears to be almost polypetalous. In the various species of this section the corolla may be glabrous or hairy within, the anthers glabrous or bearded at the base and the ovary and style either hairy or glabrous.

The second section (**Lanigerae**) also contains species hairy or glabrous as to anthers, ovary and style, but is differentiated by the corolla being provided at the throat with long woolly hairs, and in the corolla tube being about equal in length to the lobes. These two sections contain some thiry-five species. but it is probable that they are not perfectly natural groups, and some of the short-tubed species with woolly hairs at the throat should perhaps be placed among those where the corolla tube approximates in length to the lobes. *S. angustiflora* from Hongkong finds a place in the key to this section, owing to the splitting of the corolla tube producing lobes equal in length to the tubular part of the corolla; but its proper affinity is no doubt among the long-tubed species near to *S. Nux-vomica*.

The third section (**Penicillatae**) appears to be quite a natural and well-defined group, being differentiated by the occurrence of a line of erect bristle-like hairs either across the base or across the middle of the inner face of the corolla lobes. Of the twenty-six species included in the group all except two have glabrous ovaries and styles. The two exceptional cases are species from New Guinea recently described by Gilg which have not been seen; but from the descriptions and figures it would appear that they should be included in this group. All the species in this section have a marked general facies so much so that it is possible for anyone familiar with the genus to assign with some confidence certain flowerless specimens to this subdivision. The anthers are bearded at the base, with the single exception of another New Guinea species *S. Ledermannii*, Gilg & Benedict, which very possibly may not belong to this section.

Had the importance of the character of the corolla hairs in the different species of *Strychnos* been fully recognized by others who have studied the genus, it would have been of value to compare the inter-relationships between the Indian and Eastern species and those endemic in Africa and America. This, however, is unfortunately not possible until a complete re-examination of the African and New World material has been made. In Africa alone some eighty species have been recognised, and many of those collected in Tropical America have not yet been properly determined.

The fourth section of the Indian and Eastern species

(**Tubiflorae**) may also be regarded as a natural one, its main distinguishing feature being the elongated cylindrical corolla tube. Sixteen well-defined species are assigned to this group, and it would appear that relatively large fruits and seeds are correlated with long-tubed flowers; in the case of five species, however, the fruits are unknown. Two other imperfectly known species, *S. donnaiensis* and *S. usitata*, from Cochin-China, no doubt also belong to this section, making a total of eighteen species.

The section falls naturally into two divisions or sub-sections. In one which contains nine well-known and the two imperfectly known species just mentioned, the inflorescences terminate leafy axillary shoots and *S. Nux-vomica* is the typical species. In the other sub-section the flowers are arranged in short, axillary inflorescences furnished only with minute bracts. Of this sub-section *S. Ignatii*, Berg., is the best known species. Glabrous anthers inserted at the top of the corolla tube are characteristic of all the members of the section and the ovary is glabrous in all cases. *S. Wallichiana*, which is placed in this sub-section, should perhaps be more properly put in a division by itself as its long inflorescences, hairy corolla lobes and long style beset with hairs, differentiate it very markedly from all other species with a long corolla tube. *S. angustiflora* also occupies a peculiar position in the *Nux-vomica* sub-section with its deeply split corolla tube, but from the general structure of the flowers, inflorescences and fruits its natural affinity is with the long-tubed species. In the following account the various species are arranged in key form under these four sections.

Habit.

Strychnos is essentially a genus of climbing woody plants living for the most part in moist tropical forests, a few are described as shrubs, and at least six of the species under consideration are trees, namely, *S. Nux-vomica*, *S. Nux-blanda*. *S. potatorum*, *S. arborea*, *S. ligustrina* and *S. polyantha*. There is also probably, in addition to these, another tree in Queensland of which the wood only is known. The tree species are found in relatively dry localities, and occur either in open country or in the drier deciduous forests. It is unfortunate that the information given by collectors as to the general conditions under which the species were growing is as a rule very meagre.

Economic Properties.

Economically, the two most important species dealt with are *S. Nux-vomica* and *S. Ignatii*, on account of the strychnine and brucine contained in the seed. The seeds of *S. lucida*, *S. cinnamomifolia*, and possibly other species, also contain a fair percentage of alkaloids, but there is no evidence that they have been commercially exploited. The bark of *S. Gautheriana*, Pierre, known under the native name "Hoàng Nàn", is said to be very efficacious in cases of leprosy and also to be employed by the natives in Tonkin as an antidote for hydrophobia.*

* Kew Report. 1877, p. 31; Lesserteur, Le Hoàng Nàn, 1879, and *Kew Bull.* 1911, p. 289, where other references are given. See also *S. Gautheriana* (p. 203), where the subject is further discussed.

S. colubrina from S. India has been in repute from early times, under the name "lignum colubrinum," as a specific for snake bite, and it is also used as a tonic in dyspepsia and malaria by the Hindus, no doubt on account of the strychnine contained in the wood of the root. This alkaloid also occurs in the wood and bark of *S. Nux-vomica* (see Fluckiger & Hanbury, Pharmacographia, p. 430), and possibly of other S. Indian species, and it is probable that the products of more than one species of *Strychnos* pass under the name "lignum colubrinum." Rumphius's *Arbor ligni colubrini* is *S. ligustrina*, a species quite distinct from the Indian plant. The bark of the root of *S. Tieuté* also contains strychnine, and yields the poison known in Java as Radja or Tieuté.

The bark of the roots of *S. quadrangularis*, A. W. Hill, from Perak, is used as an arrow poison by the Sakais, and strychnine no doubt also occurs in the root bark of *S. ovalifolia*.

The pulp of the fruits of *S. Nux-vomica* is readily eaten by birds and also by monkeys in India (Fluckiger & Hanbury l.c. p. 428) though it contains some strychnine, and the Shans are said by Burkill to eat the pulp of the fruit of *S. Nux-blanda*, A. W. Hill, which is probably—like the seeds—almost free from alkaloid.

The seeds of *S. potatorum* are well known for their property of clearing muddy water, and the fruit pulp is edible.*

The trees yield good timber which is heavy and close-grained, and characteristically marked with white spots in transverse section (or white streaks in longitudinal section) due to patches of interxylary phloem. Watt Dict. Econ. Prod. India, vi. p. 382 mentions, under *S. Nux-vomica that* "in Burma the wood is used for making carts and agricultural implements and for fancy cabinet work." This, however, as will be shown later, must refer to *S. Nux-blanda* since *S. Nux-vomica* does not occur in Burma.

Among the results of the present investigation perhaps the most interesting is the recognition of this Burmese tree—previously referred to *S. Nux-vomica*—as a distinct and very definite species. Not only can it be recognised by certain well-marked floral and foliage characters, but the fruits and seeds differ in form from those of *S. Nux-vomica*, and the seeds do not contain any appreciable quantity of alkaloid. *S. Nux-vomica* occurs in Ceylon, India extending to Bengal, and is also found in French Indo-China, while *S. Nux-blanda*, the new species, ranges from Manipur, all through Burma to Siam and Cochin-China. Like *S. Nux-vomica*, it is a native of the drier regions and deciduous forests. The recognition of *S. Nux-blanda* has now made it possible to assign to its proper place the Wallichian specimen 1593 from Assam, consisting of leaves only, which Wallich placed under *S. acuminata*.

Geographical Distribution.

Another feature of interest concerns the geographical distribu-

* For further particulars as to the economic uses of the seeds, etc., of *S. potatorum* and *S. Nux-vomica*, see Watt. Dict. Econ. Prod. India.

tion of the species. In the Philippine Islands thirteen distinct and well-marked species have been described and at least six more are represented by imperfect specimens in herbaria. It would appear, though the evidence needs confirmation, that the species are remarkably endemic and that each island tends to have its own particular species which do not occur in the other islands of the group. *S. Ignatii* affords an exception, since it has been collected in Mindanao, Leyte, Samar and Biliran. But these islands are not far apart and, moreover, the wider distribution may be explainable on the grounds of the economic importance of the seeds. Whether *S. multiflora* is confined to the Island of Luzon or whether it also occurs in some other islands is still doubtful; and until better specimens with fruits can be collected of the *multiflora*-like plants from Mindanao, Mindoro, etc., the point must remain unsettled.* A re-examination of the specimens, however, suggests that the species is probably endemic in Luzon. At present we know the following endemic species in these islands:—

Luzon.—*S. multiflora, S. luzonensis, S. Merrillii*, and five imperfect but apparently distinct species.

Mindanao.—*S. Ignatii, S. dubia, S. lanata, S. similis.*

Paragua.—*S. ovata, S. oleifolia, S. impressinervis*, and one imperfect but quite distinct plant.

Leyte.—*S. Ignatii, S. Wenzelii.*

Samar.—*S. Ignatii, S. tesseroidea.*

Biliran.—*S. Ignatii.*

Panay.—*S. panayensis.*

Ticao, Culion and **Mindoro** are each represented by distinct but insufficiently known specimens in our herbaria.

The Philippine species belong to all four sections into which the genus has been subdivided, *S. Ignatii* being the only member of the long-tubed section. As might be expected, none of the Philippine species occur outside the group. *S. similis* shows some similarity to *S. barbata* from New Guinea and also to *S. laurina* from Malaya, but in the absence of complete material the degree of real affinity must remain a matter of conjecture. The relationship of the species belonging to the section *Penicillatae* to extra-Philippine species is no doubt close, but the plants from the islands are very clearly differentiated not only from species native of other regions but also among themselves. *S. Ignatii*, Berg., one of the most striking of the Philippine

* See p. 162 and *Kew Bull.* 1911, p. 300. Since these pages were sent to press, Mr. Merrill, Botanist, Bureau of Science, Manilla, has written as follows:—"In regard to *Strychnos multiflora*, after examining the specimens here, I am inclined to limit the species to Luzon and Mindoro; on account of the imperfect condition of our Mindoro specimens I am not quite sure that they are actually referable to this species. The Culion plant has very immature fruit, and I believe that additional material will show that this too is distinct from *S. multiflora*. I should refer the Clemens specimens from Mindanao to *S. lanata*, but the other Mindanao specimens appear somewhat different. I do not think that any of the Mindanao specimens should be referred to *S. multiflora*, but additional material will be necessary before the specimens can be definitely placed."

species may be related to *S. ovalifolia*, of Malaya, and to *S. cuspidata*, from Borneo, but with its trigonous seeds and large fruits it is unlike any other species, and must be regarded as a plant of considerable antiquity.

The genus therefore appears to afford valuable material for the study of the problems of endemism in the Archipelago, which with the increase of our knowledge will well repay further and more detailed investigation.

The Flora of Ceylon has recently been examined with regard to its endemic constituents, and as Trimen's Flora has been taken as the basis from which deductions have been drawn it is worth while to enquire whether this re-investigation of the genus *Strychnos* affects the discussion to any extent.

Trimen catalogues seven species, three of which he considers endemic in Ceylon; one of these three, however, *S. cinnamomifolia*, is represented in Travancore by so closely allied a variety that the plants from the two localities might almost be considered to be identical. Two varieties, *S. colubrina* var. *zeylanica*, Clarke (=*S. trichocalyx*, A. W. Hill). and *S. Beddomeii* var. *coriacea* (=*S. coriacea*, Thw.), which he places with the plants common to India and Ceylon, have been wrongly assigned to their respective species by C. B. Clarke, and each is now found to be a good species.

The re-examination of all the available material, which is by no means good, has resulted in the recognition of nine Singalese species of *Strychnos*, five of which are endemic. Two of these are represented in S. India by closely allied but easily distinguished species, and three appear to be peculiar to the island.

Particulars are set out in tabular form.

Ceylon.	S. India.	Andaman Is.
Endemic species.	Representative species.	
S. Benthami, Clarke and vars.	None.	
S. coriacea, Thw. ...		
S. tetraqona, A. W. Hill...		
S. micrantha, Thw. ...	*S. colubrina*, Linn.	
S. trichocalyx, A. W. Hill	*S. Dalzellii*, Clarke.	
S. cinnamomifolia, Thw....	*S. cinnamomifolia*, Thw. var. *Wightii*, A. W. Hill.	*S. tubiflora*, A. W. Hill.
Species common to Ceylon and India.		
S. lenticellata, A. W. Hill	*S. lenticellata*, A. W. Hill.	
S. Nux-vomica, Linn. ...	*S. Nux-vomica*, Linn.	
S. potatorum, Linn. ...	*S. potatorum*, Linn.	

Of the species common to Ceylon and India, three (*S. Nux-vomica*, *S. potatorum* and *S. lenticellata*) are dry country plants, and their occurrence in the drier parts of Ceylon. which may be considered both from the physical and geographical standpoint to be part of India, is to be expected. *S. cinnamomifolia* is a moist country plant of the tropical forests, and occurs in India in the forests of Travancore, etc. Here, again, physical conditions are very similar, and the floras of the two regions show

many species in common. It is interesting to notice that a species apparently closely allied to *S. cinnamomifolia* is found in the Andaman islands, but it is sufficiently distinct to be raised to specific rank, and has been described under the name *S. tubiflora*, A. W. Hill. There is also some evidence that *S. cinnamomifolia* may occur in the tropical forests of Silhet, and *S. Pierriana*, A. W. Hill, from Annam (see p. 197) appears to be a very closely allied species.

The species endemic in Ceylon are of interest. *S. micrantha* and its closely allied representative species *S. colubrina* inhabit moist low country somewhat similar to the habitat of *S. cinnamomifolia*. *S. trichocalyx*, and its Indian representative *S. Dalzellii*, appear to be somewhat dry country plants, judging from their general facies and their stout coriaceous leaves. In these two species the hairs on the inside of the calyx lobes are unique in the genus at least as far as the eastern species are concerned. Of the three remaining endemic species *S. Benthamii* with its 4-merous flowers is quite a distinct species peculiar to Ceylon, and occurs as might be expected in the central and southern regions. *S. coriacea*, also peculiar, inhabits the central province, and *S. tetragona* is apparently a low country plant. With its trinerved, closely-veined leaves and glabrous ovary the latter species shows some resemblance to *S. aenea*, A. W. Hill, from Travancore. The anthers, however, in the Ceylon plant are slightly bearded, and the resemblance between the two species may only be superficial. It has seemed desirable to refer to the Ceylon species of *Strychnos* in some detail since erroneous deductions might be drawn from the statements published in Trimen's Flora.

In referring to the Ceylon species the distribution of some of the Indian species has also been considered. There remain, however, in S. India *S. bicirrhosa*, Lesch., from Tanjore, which has not been collected since it was originally found by Leschenault; and *S. colubrina*, the well-known endemic species of the Malabar and Canara coast region.

S. aenea. A. W. Hill, which like *S. cinnamomifolia* var. *Wightii* is a Travancore plant is, like that species, apparently also found in Silhet. The Assam specimens, however, are imperfect and differ in having more abruptly acuminate leaves, but they are so similar to the type from S. India that they have been described as a variety under the name *acuminata*, A. W. Hill. Other closely allied plants, as far as can be determined, are *S. quadrangularis*, A. W. Hill, from the Perak forests, *S. Vanprukii*, Craib, from Siam, and *S. Gautheriana*, Pierre, from Annam (see p. 203).*

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* The Sonerilas of the group *S. squarrosa* and *S. scapigera* occur in S.W. Ceylon, W. Ghats to Bombay, and from Malacca to the Khasia hills and Sikkim (*see* Stapf in Ann. Bot. vi, p. 306). *Chrysophyllum Roxburghii*, G. Don; *Cosmostigma racemosum*, *Fagraea obovata*, Wall. *Pajanila multijuga*, DC. *Sterculia urens*, Roxb. *Dysoxylum binectariferum*, Hook. f. *Amoora Rohituka*, Wight & Arn. *Gomphandra axillaris*, Wall., *Salacia prinoides*, DC. *Ficus retusa*, and *F. nervosa*, show a similar geographical distribution to *Strychnos aenea*, A. W. Hill, and *S. cinnamomifolia* var. *Wightii*.

The Malabar flora shows considerable affinity with that of the Khasia hills and Malaya, as Sir Joseph Hooker pointed out in his Introductory Essay to the Flora Indica (p. 123), and as regards climate, humidity, etc., these regions are remarkably similar. The occurrence therefore of one or two of the same or of closely representative species of *Strychnos* in S.W. India, the Khasia Hills and Malaya is not surprising, although as a rule the range of the several species appears to be restricted.

The Khasia Hills have in addition two endemic species, *S. axillaris*, Colebr., belonging to the section *Penicillatae*, of which several other species are recorded from Indo-China, Malaya, etc., and *S. Wallichiana*, Benth., a very distinct species, which occurs in Silhet, Chittagong and the Lushai hills, with a variety *intermedia*, in Chittagong and a second variety *ovata*, in Pegu.

The typically S. India and Ceylon species *S. potatorum* is also recorded from Prome and Pegu, but *S. Nux-vomica* does not occur, and is represented in Burma and Siam by *S. Nux-blanda*.

The Malayan and Indo-Chinese region is rich in species of *Strychnos*. Ten belong to the section *Penicillatae* and, with the exception of *S. pubescens* which apparently extends to Borneo, they appear to be endemic and well defined. Of the three representative of the section *Brevitubae*, *S. hypogyna* from Tenasserim is nearly related to *S. andamanensis*, but *S. Maingayi* and *S. hirsutiflora* from Perak, are both very distinct and peculiar species.

In the section *Lanigerae*, *S. laurina* from Tenasserim apparently occurs also in Cochin-China and in Borneo, but the evidence rests mainly on the bearded anthers, and it would be unwise to draw deductions as to the inter-relationships of the six species numbered 16–21 in the Key (three of which come from New Guinea and are probably quite distinct, and one from Mindanao, in the Philippines), as in no case is the material sufficiently complete. *S. flavescens*. King & Gamble, from Perak, Penang and Singapore, and *S. Curtisii*, King & Gamble, from Perak and Penang, are well defined species, and are probably endemic.

The only long-tubed *Strychnos* found in the Malay Peninsula proper is *S. ovalifolia*, Wall.; it occurs in Perak, Penang, Malacca and Singapore and extends to Borneo. *S. Tieuté*, Lesch., from Java, is no doubt a closely allied species. Several long-tubed species are known to occur in Cochin-China, but most of the specimens are unfortunately very incomplete. The species from Borneo, Java and Sumatra are distinctly Malayan in their affinities, but it is clear that in Borneo at least there are several species awaiting discovery.

Of the thirteen species described from New Guinea* and Amboina, *S. Forbesii*, *S. barbata* and *S. Robinsonii* are the only ones represented in British herbaria. The two former are evidently closely allied, and show considerable similarities in their flowers

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* Gilg & Benedict in Engl. Bot. Jahrb. liv.

and in the possession of large fruits, and probably they are not very nearly related to species from other regions.

Five species, including *S. Robinsonii*, appear to belong to the section *Pencillatae*, but two differ from all others in this section in having pubescent ovaries, and *S. Robinsonii*, is particularly distinguished by its large leaves. No long-tubed species of *Strychnos* is as yet known from New Guinea.

The only species which remain for general consideration are the four from Australia; *S. vitiensis*, the endemic species of the Fiji islands, a plant of very uncertain affinity; the two species from Hongkong and the two imperfectly known species from Formosa and the Celebes respectively.

Of the Australian species *S. lucida*, from the north coast, is closely allied to *S. ligustrina* from Timor and belongs to the *Nux-vomica* subsection of the genus; *S. psilosperma* and *S. arborea* belong to the section *Penicillatae*, and are endemic and quite distinct—*S. arborea* being peculiar, as it is a small tree. *S. Bancroftiana* is very different from any other Australian species; it seems to belong to the *Lanigerae* section of the genus, but flowers are unknown and it may prove to be allied to some New Guinea species, as may also be the case with *S. arborea* and *S. psilosperma*.

The two Hongkong species show no particular affinity to each other. *S. paniculata* has a very short corolla tube and is 4-merous, while *S. angustiflora* has a long cylindric corolla and a large fruit with seeds resembling those of *S. Nux-vomica*. This species no doubt belongs to the *Nux-vomica* subsection of the genus, and the character of the inflorescences also strengthens this assumption, but, owing to splitting, the corolla lobes are almost equal in length to the tube. It is possible that species may be discovered in Cochin-China which will link *S. angustiflora* and *S. Nux-vomica* more closely.

From these introductory remarks it will be obvious that it is not yet possible, even with the large number of fairly well-known species, to suggest definite answers to the interesting questions which are concerned with the geographical distribution of the genus *Strychnos* in India and the East.

The specimens preserved in the Herbaria at Kew, the British Museum, Edinburgh, Glasgow and Paris have been examined, and I am indebted to the Regius Keeper of the Royal Botanic Gardens, Edinburgh, and to Prof. Bower for the loan of specimens. The Superintendent of the Royal Botanic Gardens, Calcutta, also kindly sent over the very rich collection from the Calcutta Herbarium, and I am much indebted to Mr. E. D. Merrill for copious material of *Strychnos* from the Bureau of Science Herbarium, Philippine Islands, and for valuable information. From the Madras and Travancore Herbaria material has also very kindly been sent on loan to Kew. Mr. J. S. Gamble sent the collection from his private herbarium for examination, and I am also indebted to Prof. H. Lecomte for portions of specimens and for much kind assistance during my recent visit to the Museum d'Histoire Naturelle, Paris. Prof. H. Jumelle has kindly sent specimens and seeds of *S. Nux-vomica*

from Cochin-China from the Colonial Museum, Marseilles; and from Dr. Ostenfeld have been received specimens of the two species of *Strychnos* collected on the Danish Expedition to Siam. Specimens of *S. arborea* have kindly been sent by Mr. Maiden from New South Wales, and Mr. White, Acting Government Botanist, has sent interesting Queensland specimens from the Brisbane Herbarium. To Mr. Petch I am indebted for useful material, with ripe fruits and seeds, from Ceylon. The specimens preserved at Kuala Lumpur have also been examined. Unfortunately the Singapore specimens have not been seen, as the risk in having them sent over was considered to be too great.

Clavis specierum.

Section i. **Brevitubae.**

Corollae tubus brevis, lobis tubo longioribus lobis et fauce glabris vel laneo-tomentosis.

Corollae lobi 4 ... ... 1. *S. paniculata.*

Corollae lobi 5 :—

Folia trinervia :—

Antherae glabrae ; inflorescentiae breves, glabrae, compactae :—

Inflorescentiae pauciflorae ; corollae tubus 0·5 mm. longus, lobi marginibus fimbriatis ... ... 2. *S. aenea.*

Inflorescentiae densiflorae ; corollae tubus 1–1·25 mm. longus, lobi marginibus glabris ... ... 3. *S. Vanprukii.*

Antherae barbatae ; inflorescentiae paniculatae, pubescentes :—

Ovarium cum stylo glabrum ; ramuli minute pubescentes ... ... 4. *S. tetragona.*

Ovarium cum stylo hirsutum ; ramuli glabri :—

Antherae dense barbatae ; corolla extra glabra ... ... 5. *S. Maingayi.*

Antherae paullo barbatae ; corolla extra parce pubescens ... 6. *S. ovata.*

Folia triplinervia vel subquintuplinervia :—

Corolla externe hirsuta vel puberulenta :—

Folia ramulique glabri ; corolla intus glabra vel subglabra :—

Ovarium glabrum ; antherae paullo barbatae ... ... 7. *S. villosa.*

Ovarium puberulum ; antherae glabrae ... ... 8. *S. lanceolaris.*

Folia ramulique pubescentes ; corollae lobi intus pilis laneis obtecti :—

Folia superne glabra ; antherae 0·4 mm. longae ... ... 9. *S. hirsutiflora.*

Folia omnino minutissime pubescentia ; antherae 0·65 mm. longae ... ... 10. *S. bicirrhosa.*

Corolla externe glabra :—
Ovarium glabrum ; antherae barbatae 11. *S. vitiensis.*
Ovarium hirsutum vel subhirsutum ;
antherae glabrae :—
Calycis segmenta rufo-pubescentia,
obtusa ; corolla 2–2·5 mm.
longa ... ... 12. *S. hypogyna.*
Calycis segmenta glabra, subacuta ;
corolla 4·5–5 mm. longa ... 13. *S. andamanensis.*
Ovarium hirsutum ; antherae barbatae 14. *S. panayensis.*

Section ii. **Lanigerae.**

Corolla ad faucem vel versus basin loborum et in parte tubi superiore pilis laneis instructa ; lobi et tubus plus minusve aequilongi.
Corollae lobi tubo plus minusve aequilongi :—
Antherae basi plus minusve barbatae :—
Folia trinervia :—
Ovarium glabrum ; corolla 2·5 mm.
longa, externe hirsuta ... ... 22. *S. flavescens.*
Ovarium hirsutum ; corolla 4 mm.
longa, externe glabra ... ... 15. *S. cinnamophylla.*
Folia triplinervia ; ovarium hirsutum ;
corolla 4·5–7 mm. longa, externe glabra :—
Corollae tubus pilis laneis longitudinaliter instructus ... ... 16. *S. septemnervis.*
Corollae tubus, fauce excepto, glaber :—
Corolla 4 mm. longa, ad faucem paullo hirsuta ; ovarium cum stylo parce hirsutum ; pedunculi glabri ... ... 17. *S. Forbesii.*
Corolla 5-6 mm. longa, ad faucem dense hirsuta ; ovarium cum stylo dense hirsutum ; pedunculi pubescentes :—
Folia ovata, paullo triplinervia ... 18. *S. laurina.*
Folia elliptica, conspicue triplinervia :—
Folia anguste elliptica ; antherae fusco - virides ; filamenta 0·75 mm. longa ... ... 19. *S. similis.*
Folia late elliptica ; antherae flavae ; filamenta 1·75–2 mm. longa ... ... 20. *S. barbata.*
Antherae glabrae :—
Ovarium glabrum :—
Folia quintuplinervia ; arbor... ... 21. *S. potatorum.*
Folia trinervia ; frutices :—
Corolla externe hirsuta, 2·5 mm.
longa ; antherae raro subglabrae 22. *S. flavescens.*
Corolla externe glabra, circiter 1 cm.
longa ... ... 62. *S. angustiflora.*

Ovarium hirsutum :—
Folia trinervia :—
Corolla externe hirsuta ... ... 23. *S. coriacea.*
Corolla externe glabra :—
Corolla 1·1 cm. longa, intus omnino dense hirsuta ... 24. *S. polytrichantha.*
Corolla intus ad faucem hirsuta ; lobi parte superiore glabri :—
Inflorescentiae 8–10 cm. longae :—
Corolla circiter 5·5 mm. longa ; tubus lobis longior ; stylus glaber ... ... 25. *S. dubia.*
Corolla 8 mm. longa ; lobi tubo longiores ; stylus hirsutus ... ... 26. *S. oleifolia.*
Inflorescentiae 2-3·5 cm. longae ; corolla 4 mm. longa ; stylus hirsutus :—
Folia anguste elliptico-lanceolata, acuminata, trinervia vel subtriplinervia ; corollae lobi tubo aequilongi ... 27. *S. micrantha.*
Folia ovato-elliptica, acuta vel acuminata, trinervia vel subtriplinervia ; corollae lobi tubo paullo longiores ... ... 28. *S. colubrina.*
Folia triplinervia :—
Corolla 3·5–4 mm. longa ; antherae orbiculares, 0·65 mm. longae ; stylus hirsutus ; folia parva, glabra, mucronulata ... ... 29. *S. lenticellata.*
Corolla circiter 5 mm. longa ; antherae 0·75–1 mm. longae, oblongae ; stylus hirsutus ; folia acuta vel acuminata :—
Corollae lobi externe minute pubescentes ; foliorum nervi inferne parce pubescentes ... 30. *S. Merrillii.*
Corollae lobi externe glabri ; folia glabra :—
Corollae tubus parte inferiore pilosus ; folia sensim acuta, 8–12 cm. longa ... ... 16. *S. septemnervis* **var.** *imberbis.*
Corollae tubus parte inferiore glaber ; folia abrupte acuminata, 14–20 cm. longa :—
Antherae subsessiles ; inflorescentiae 3·5–6 cm. longae ... ... 31. *S. pycnoneura.*

Antherae filamenta 1·5 mm. longa ; inflorescentiae 12–14 cm. longae ... 32. *S. myriantha.*
Corolla 6–7 mm. longa ; antherae 1·65 mm. longae, oblongae ; stylus glaber ; folia magna, acuta vel acuminata ... ... 33. *S. multiflora.*
Corollae lobi tubo 2.5 mm. longo longiores :—
Antherae 1 mm. longae ; filamenta elongata ; folia subtriplinervia vel trinervia ... ... 34. *S. Curtisii.*
Antherae 2 mm. longae ; filamenta brevia ; folia triplinervia ... ... 35. *S. lanata.*

Section iii. **Penicillatae.**

Corollae lobi linea pilorum erectorum instructi.
Corollae lobi linea pilorum ad basin instructi ; antherae filamenta in tubo corollae inserta :—
Corollae lobi 4 ... ... 36. *S. Benthami.*
Corollae lobi 5 :—
Folia quintuplinervia :—
Folia 8–10 cm. longa, glabra ... 37. *S. quintuplinervis.*
Folia 4·5–6 cm. longa, pubescentia... 38. *S. pubescens.*
Folia triplinervia vel subtriplinervia :—
Plantae glabrae :—
Folia ovata, 5·5–8 cm. longa ; corollae lobi pubescentes ... 39. *S. Ridleyi.*
Folia elliptico-lanceolata, 10–16 cm. longa ; corollae lobi (linea pilorum excepta) glabri ... 40. *S. Robinsonii.*
Plantae pubescentes :—
Folia omnino rufo-pubescentia : antherae basi et ad margines barbatae ... ... 41. *S. Scortechinii.*
Folia nervis paginae utriusque pubescentibus ; antherae basi tantum barbatae ... ... 42. *S. axillaris.*
Folia trinervia :—
Folia ovata vel ovato-lanceolata, subcoriacea :—
Caules uti folia glabri ... ... 43. *S. Schmidtii.*
Caules, petioli et nervi plumoso-pubescentes :—
Caules paullo pubescentes, spinis axillaribus armati ; corolla externe glabra ... 44. *S. armata.*
Caules dense pubescentes inermes ; corolla externe lineatim pubescens ... 45. *S. plumosa.*
Caules, petioli et folia omnino rufo-pubescentes ... ... 41. *S. Scortechinii.*

Folia rhomboideo-ovata, coriacea :—
Frutex glaber ; venae folii conspicuae ; antherae omnino barbatae ... ... 46. *S. psilosperma.*
Arbor, ramulis petiolis et nervis pubescentibus ; venae inconspicuae ; antherae basi tantum barbatae ... ... 47. *S. arborea.*
Corollae lobi intus linea pilorum erectorum medio notati ; antherae in sinubus insertae :—
Calyx intus versus basin pilis erectis plus minusve lineatim instructus :—
Folia rhomboideo-ovata, basi cuneata, angulis nervorum pagina inferiore saepius pubescentibus ... ... 48. *S. trichocalyx.*
Folia ovato-lanceolata, elongata, glabra 49. *S. Dalzellii.*
Calyx intus glaber :—
Ovarium glabrum :—
Folia quintuplinervia, ovata, basi rotundata ; caules pubescentes :—
Folia superne vernicosa, nervis plus minusve hirsutis ; inflorescentiae axillares ... 50. *S. malaccensis.*
Folia pilis pustulis minutis insidentibus ; inflorescentiae terminales ... ... 51. *S. penicillata.*
Folia triplinervia vel subquintuplinervia, elliptica, basi cuneata vel rotundato-cuneata :—
Caules glabri :—
Antherae barbatae ; pedunculi pedicellique pubescentes... 52. *S. Wenzelii.*
Antherae glabrae ; pedunculi pedicellique glabri ... 53. *S. Ledermannii.*
Caules pubescentes :—
Folia basi cuneata, nervis pagina superiore et inferiore angulis pubescentibus ; calycis segmenta glabra ... ... 54. *S. Horsfieldiana.*
Folia basi rotundato-cuneata, nervis et angulis glabris vel subglabris : calycis segmenta pubescentia ... 55. *S. palembanica.*
Folia triplinervia vel subtrinervia ovato - lanceolata, acuminata, basi rotundata, 8–13 cm. longa ; caules glabri vel minute pubescentes :—
Caules glabri ; folia venis approximatis ; inflorescentiae terminales ... ... 56. *S. luzonensis.*

Caules in juventute minute pubescentes ; folia venis distantibus ; inflorescentiae axillares vel terminales ... 57. *S. impressinervis.*

Folia trinervia, ovata, 3–6 cm. longa ; caules dense pubescentes :—

Folia emarginata ; inflorescentiae 3–5-florae ... ... 58. *S. mucronata.*

Folia sensim acutata ; inflorescentiae densiflorae ... ... 59. *S. oophylla.*

Ovarium brevissime pilosum :—

Folia ovata, acuta, petiolis glabris ; inflorescentiae pauciflorae ... 60. *S. melanocarpa.*

Folia ovata, longe acutissime acuta ; petiolis parce pilosis ; inflorescentiae multiflorae ... ... 61. *S. polytoma.*

Section iv. **Tubiflorae.**

Corolla cylindracea, elongata, tubo—*S. angustiflora* excepta—lobis multo longiore.

Inflorescentiae ramulos axillares foliatos terminantes :—

Corolla fissa, lobis tubo plusminusve aequilongis ... ... 62. *S. angustiflora.*

Corolla tubo lobis multo longioribus :—

Arbores :—

Folia magna, 5-7-nervia; corollae tubus intus pilosus :—

Folia 5-nervia, sensim subacuta, usque ad 15 cm. longa ; antherae non-apiculatae ; semina orbicularia, nitide sericeo-hirsuta ... ... 63. *S. Nux-vomica.*

Folia 5-7-nervia, abrupte acuta vel acuminata, usque ad 22 cm. longa ; antherae apiculatae ; semina irregulariter ovoidea, indumento contexto hebete obtecta ... 64. *S. Nux-blanda.*

Folia parva, emarginata, 3-nervia ; corollae tubus intus glaber... 65. *S. ligustrina.*

Frutices vel scandentes :—

Frutex ; ramuli divaricati ; folia griseo-viridia ; corollae tubus intus glaber ... ... 66. *S. lucida.*

Scandentes ; corollae tubus intus pilosus :—

Folia triplinervia ; pedicelli pubescentes ; pericarpium crassum, conspicue verruculosum ... ... 67. *S. cinnamomifolia* et var. *Wightii.*

Folia trinervia; pedicelli pubescentes vel glabri :—
Folia ovata, abrupte acuta vel acuminata; pedicelli glabri; pericarpium crassum, verruculosum 68. *S. tubiflora.*
Folia ovata, acuta; pedicelli pubescentes; pericarpium tenue, laeve ... 69. *S. rupicola.*
Folia elliptica, abrupte acuminata vel acuta; pedicelli pubescentes; pericarpium crassum ... 70. *S. Pierriana.*
Inflorescentiae axillares efoliatae : —
Inflorescentiae elongatae, multiflorae; stylus hirsutus ... ... 71. *S. Wallichiana.*
Inflorescentiae breves; stylus glaber :—
Corollae lobi villosi ... ... 72. *S. Spireana.*
Corollae lobi glabri :—
Folia trinervia vel subtriplinervia :—
Corolla 8 mm. longa; tubus intus dense lanatus; folia longe acuminata... ... 73. *S. cuspidata.*
Corolla 1·2–1·5 cm. longa; tubus intus paullo lanatus :—
Folia ovata; bacca 4–5 cm. diametro; semina elliptica vel rotundata, compressa.. 74. *S. Balansae.*
Folia elliptica vel obovato-elliptica; semina subtrigona, cornea ... ... 75. *S. Ignatii.*
Folia triplinervia :—
Semina pilis laneis intertextis dense vestita ... ... 76. *S. Tieuté.*
Semina pilis sericeis nitentibus dense vestita ... ... 77. *S. ovalifolia.*

Section i. **Brevitubae.**

1. **S. paniculata,** *Champ.* in Hook. Kew Journ. Bot. v. p. 56, descr. emend.

Corolla 3·75–4 mm. longa, ad faucem pilis longis laneis instructa, tubo 1 mm. longo. *Antherae* 1·25 mm. longae, basi retrorso-villosae. *Ovarium* glabrum, stylo 2·5 mm. longo glabro vel subglabro; Benth. in Proc. Linn. Soc. Bot. i. p. 102; Walp. Ann. v. p. 508; Benth. Fl. Hongk. p. 232; Forbes & Hemsley, Ind. Flor. Sin. ii. p. 121; Dop in Bull. Soc. Bot. Fr. lvii. Mém. 19. (1910), p. 15; Dunn & Tutcher, Flora of Kwantung and Hong Kong, Kew Bull. Add. Ser. x. 1912, p. 174.

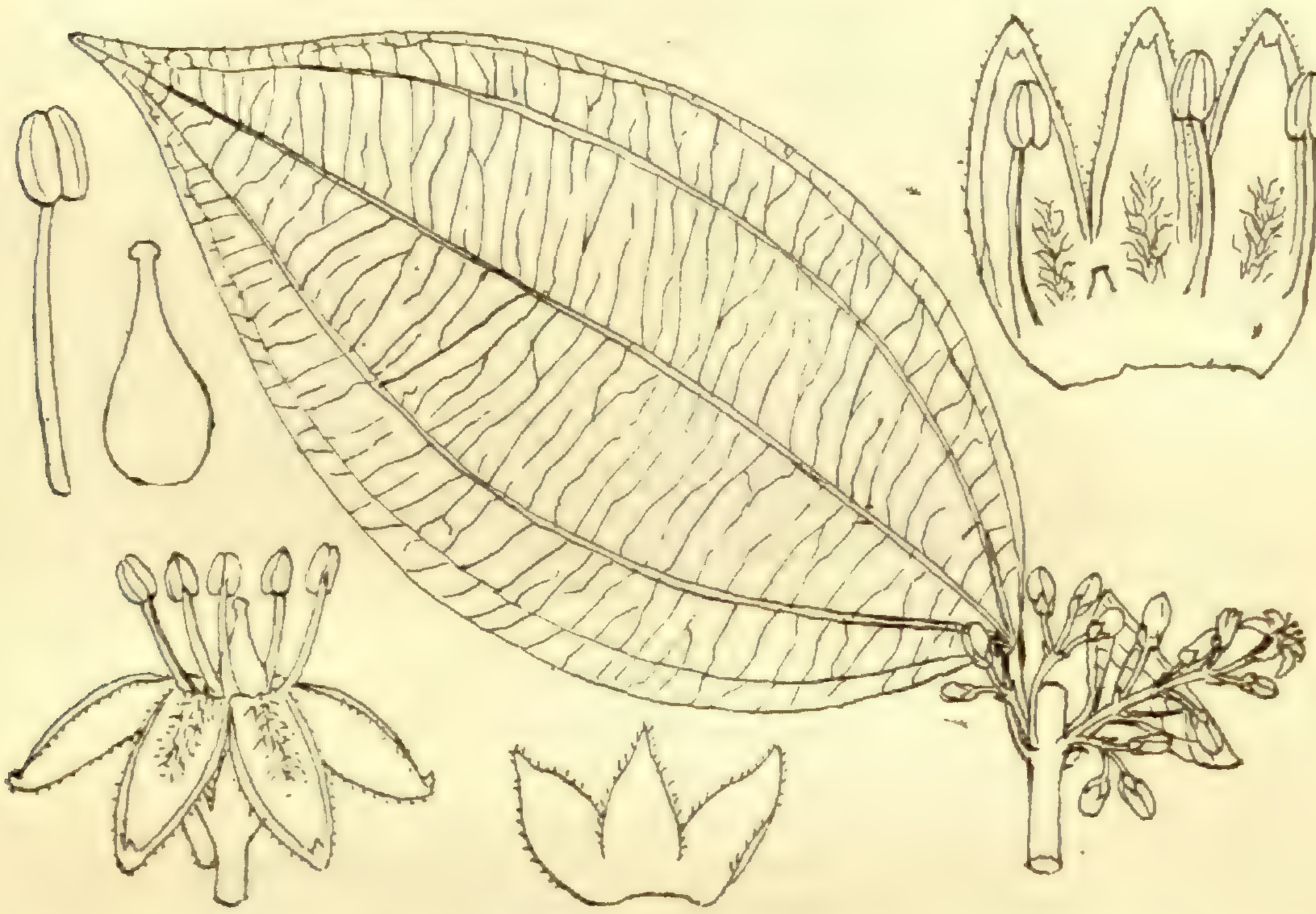
Hongkong. *Wright* 267; *Champion* 329; *Wilford* 429.

Kwantung. Canton, *Reeves.*

This species is easily distinguished by its 4-merous flowers. The small button-like seeds are practically glabrous.

2. **S. aenea,** *A. W. Hill*; species tubo corollae breve, inflorescentiis glabris filamentis antherarum elongatis, foliis subtus aeneis distincta.

Frutex lignosus, scandens, glaber, ramis plus minusve quadrangularibus angulis subcarinatis. *Folia* ovato-lanceolata, 9-15 cm. longa, 4-6·5 cm. lata, basi cuneata vel rotundato-cuneata, apice sensim acuminata, 5-nervia, trinervia, nervis utrinque elevatis, pagina superiore in siccitate lacte viridia, inferiore aenea, venis reticulationibusque conspicuis; petioli breves; cirrhi bijugi, glabri. *Inflorescentiae* axillares, pauciflorae, circiter 2 cm. longae. pedunculis pedicellisque glabris. *Calycis* segmenta



ovato-lanceolata, acuta, 1·25 mm. longa, marginibus paullo fimbriatis. *Corolla* 3-4 mm. longa, tubo 0·5 mm. longo vel breviore; lobi elliptico-ovati, subacuti, pilis minutis marginibus et ad apices fimbriati, intra et ad faucem pilis laneis minutis instructi. *Antherae* 0·75 mm. longae, glabrae, filamentis 1·5-2 mm. longis. *Ovarium* cum stylo 0·75 longo glabrum. *Fructus* ignotus. *S. Rheedii*, Brandis, Indian Trees, p. 474, non Clarke in Hook. f. Flor. Brit. India, iv. p. 87.

S. India. Travancore: Peermerd; evergreen forests, 1120 m., *Bourdillon* 200; Ponmudi: evergreen forests, 760 m., *Bourdillon* 600; S. Canara, *Beddome* 5306 in herb. Mus. Brit.; Anamali Hills. 900 m., *Fischer* 3579; Udumanpari, *Barber* 5715.

Var. **acuminata,** *A. W. Hill*. *Folia* plus minusve late ovata, 9-10 cm. longa, 4-5·5 cm. lata, abrupte et longe acuminata, pagina inferiore aenea. *Inflorescentiae* axillares, 3-3·5 cm. longae, glabrae. *Flores* perfecti ignoti.

N.E. India. Cachar: Kala Naga, *Prazer* 171 in herb. Calc.; Khasia Mts., *Hooker & Thomson* in herb. Kew.; without precise locality, *Wallich* 1590 partim. in herb. Mus. Brit.

There is a Banksian specimen, no. 84 in the British Museum, with a note by Dryander "v. Hort. Malab. Tom. 1. tab. 37", apparently received from a Dutch collector, which should probably be referred to this species.

In the Flora of British India, Clarke gave a description of *S. Rheedii*, based entirely on the picture in Rheede Hort. Malab. viii. t. 24, and Brandis in his "Indian Trees" assigned to this species specimens from Travancore collected by Bourdillon. Rheede's figure is accompanied by no description of any value, and it is very doubtful what his plant may have been. The flowers appear to have a short tube, but the large globular fruits and flattened discoid seeds so closely resemble those of *S. Nux-vomica* that it seems highly probable they belonged to that species, while the leaves and flowers may have been those of another plant.

Under the circumstances, therefore, it seems better not to refer any of our modern specimens to Clarke's *S. Rheedii*, as Brandis has done, nor attempt to reconcile them with Rheede's figure, but to describe them as a new species and place *S. Rheedii*, Clarke, among "species excludenda." (See p. 208.)

Bourdillon describes the plant as a large woody climber, flowering in April and May. It occurs in the tropical evergreen forests of Travancore, and is especially marked in having quadrangular stems, in the trinerved leaves which when dry are copper-coloured on the under surface, and the small glabrous inflorescences. These characters are also possessed by the specimens from Perak, to which the name *S. quadrangularis*, A. W. Hill, has been given (see p. 205) and by the specimens of the true *S. Gautheriana*, Pierre, from Annam (see p. 203). Unfortunately no perfect flowers of either the Perak or Annam plants are known, though in the former the ovary and style are glabrous as in *S aenea*; and it is therefore somewhat doubtful whether the resemblances represent a real affinity. Such a distribution, however, as the moist evergreen forests of Travancore, Silhet Perak and the calcareous mountains of N. Annam is not unknown. The marked affinity of *S. aenea* with the Siamese *S. Vanprukii* is also of interest geographically.

The three specimens referred to the variety *acuminata* agree fairly closely with those of the type from Travancore, and the distribution of the species closely resembles that which apparently obtains in *S. cinnamomifolia*, Thw., and its Indian variety (see p. 194). The leaves in the variety have rather long drip tips, and the stems appear to be rounded rather than quadrangular.

3. **S. Vanprukii,** *Craib* in Kew Bull. 1911, p. 421. descr. emend.; species *S. aenea*, A. W. Hill, arcte affinis, inflorescentiis densifloris, corollae tubo longiore lobis ellipticis marginibus glabris differt.

Folia 8–17 cm. longa, 3–7 cm. lata, trinervia vel subtriplinervia. *Cymae* axillares, paniculatae, 2–3 cm. longae. *Corolla* 3-4 mm. longa, intra ad faucem praecipue pilis minutis laneis instructa, tubo 1–1·25 mm. longo. *Antherae* glabrae, filamentis

1-1·5 mm. longis instructae; Lecomte, Flor. Gén. Ind.-Chin. iv. p. 164.

Siam. Me Yuak Phre, 240 m. *Luang Vanpruk* 234; Pre Hue Oi, 300 m., *Luang, Vanpruk* 410.

The receipt of a second specimen of this species has necessitated a slight revision of the original description since the leaves are considerably smaller and the inflorescences more expanded than in the type specimen; the two gatherings agree in all other essential respects.

In his original description Craib compared the plant with *S. paniculata*, Champ.; it appears, however, to be very closely allied to *S. aenea*, A. W. Hill, from Travancore. The whitish-green of the upper surface of the leaves, short axillary panicles, triangular-acute calyx segments, the corolla lobes and throat with a covering of short woolly hairs, the anthers and the glabrous ovary and style are remarkably similar in both species. The chief points of difference are to be found in the fringe of hairs to the elliptic corolla lobes in *S. aenea*, the shorter corolla tube, the somewhat larger calyx segments, and the coloration of the under surface of the leaf. It is unfortunate that we do not know the fruits and seeds of either *S. Vanprukii* or *S. aenea*, as without them the affinity of the two species is rather a matter of conjecture.

Vanpruk describes his no. 410 as a woody climber over 50 ft. long.

4. **S. tetragona,** *A. W. Hill*, species ramulis et pedunculis tetragonis, corolla campanulata tubo breve lobis repandis, antheris barbatis, ovario glabro distincta.

Frutex ramis sulcatis in juventute tetragonis pubescentibus. *Folia* ovata vel obovato-elliptica, basi rotundata vel rotundato-cuneata, apice acute et longe acuminata, 6–9 cm. longa, 3–4 cm. lata, 5-nervia, trinervia, superne vernicosa, nervis impressis, pagina inferiore nervis minute pubescentibus petioli circiter 5 mm. longi. *Inflorescentiae* axillares, paniculatae, 2·5–5 cm. longae, pedunculis pedicellisque tetragonis sulcatis pubescentibus. *Calycis* segmenta triangulari-ovata, 0·75 mm. longa, plus minusve acuta, glabra, marginibus ciliatis. *Corolla* 3·5 cm.

longa, lobis repandis circiter 2·5 mm. longis plurime et ad faucem pilis laneis dense instructis, tubo campanulato glabro. *Antherae* circiter 1 mm. longae, ovatae, basi paullo barbatae vel subglabrae, filamentis 0·75–1 mm. longis. *Ovarium* globosum, cum stylo glabrum 2·25 cm. longum. *Fructus* ignotus. *S. micrantha*, Thwaites, Enum. Plant. Zeyl. Add. p. 425; C. B. Clarke in Hook. f. Flor. Brit. Ind. iv. p. 86; Trimen, Fl. Ceylon pt. iii. p. 172, omnes quoad *C.P.* 3720 partim.

Ceylon. Without precise locality, *Thwaites* 3720. B. in herb. Kew.

This plant, included by Thwaites under *S. micrantha*, is quite distinct from the other plants placed by him under that species. The pubescent twigs and the pubescent nerves on the under surfaces of the leaves, the short campanulate corolla tube, bearded anthers and glabrous ovary and style mark this plant as a well-defined species.

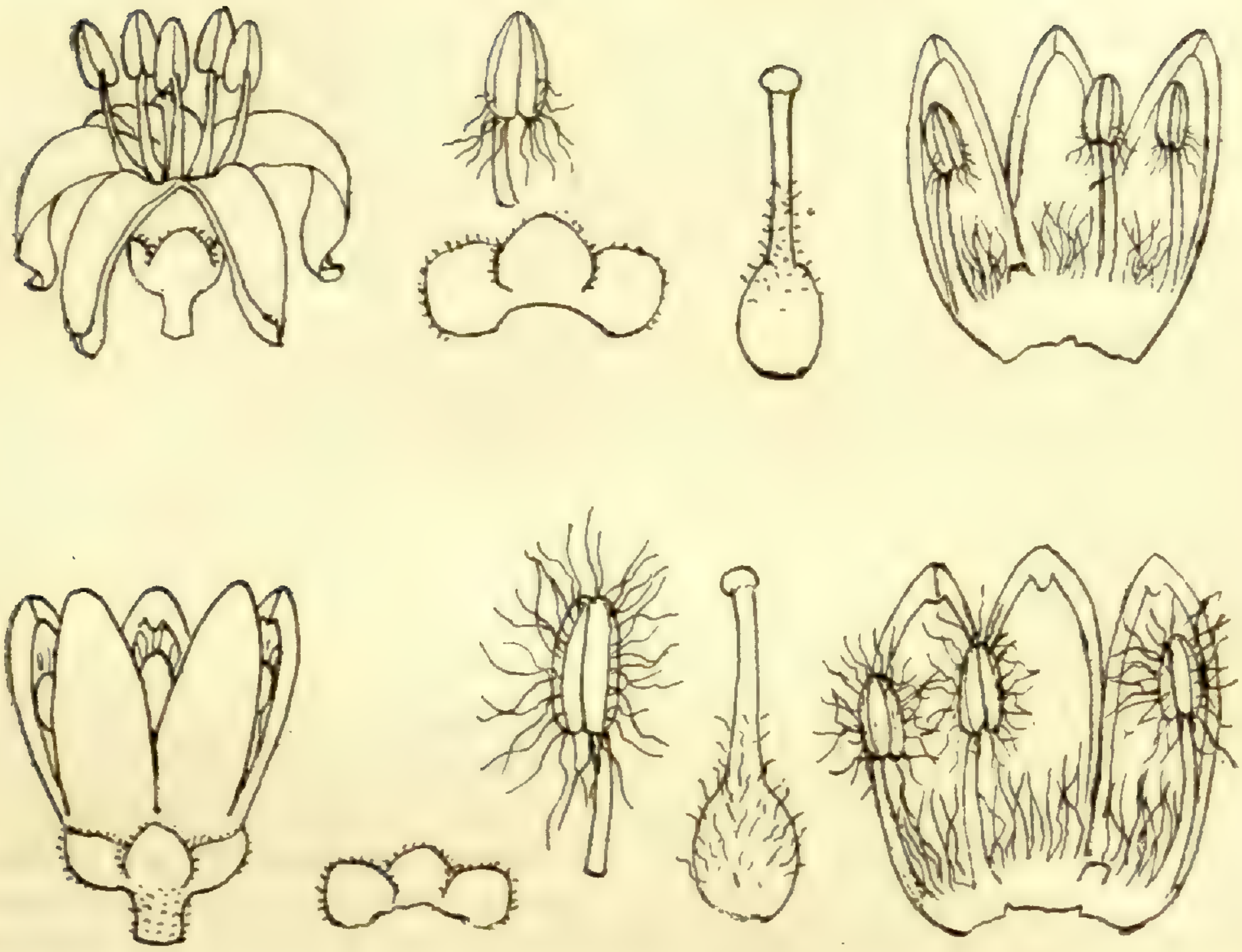
There are two distinct plants at Kew bearing the original label *Thwaites* 3720, one of which is rightly referred by Thwaites (Enum. p. 425) to *S. micrantha*. It was originally labelled *S. laurina* and is included by C. B. Clarke (Fl. Brit. Ind. iv. p. 88), under *S. Beddomei*. The other plant—the type of the new species—was also seen by Clarke and placed under *S. micrantha* (Fl. Brit. Ind. iv. p. 86), for he refers to the glabrous ovary of *C.P.* 3720, although Thwaites, in his description, states that the ovary in *S. micrantha* (Enum. p. 425), is villous. *S. micrantha*, according to Clarke, l.c., is represented by *C.P.* 3720 (B.) and *C.P.* 1866, the latter a doubtful fruiting specimen—while *S. micrantha*, Thwaites, includes *C.P.* 3540, 3720 (A)—of which there are two sheets at Kew—and 1866. In order to reconcile his own conception of *S. micrantha*, Clarke has removed nos. 3540 and 3720 (A), with the ovary hairy, to his *S. Beddomei*—which is here considered synonymous with *S. colubrina*, the South Indian species (see p. 157).

It is unfortunate that we have no definite knowledge of where this endemic species was collected. Since it bears the same number as specimens belonging to *S. micrantha*, Thw., it may perhaps be concluded that it is a native of the low country (see Trimen, Flor. Ceylon, iii. p. 172).

In its leaf and floral characters it shows some resemblance to *S. aenea*, A. W. Hill. It differs especially in the slightly bearded anthers, the pubescent stems, and larger paniculate inflorescences.

5. **S. Maingayi,** *Clarke* in Hook. f. Fl. Brit. Ind. iv. p. 88, var. excl.; descr. emend.

Corolla 3–3·25 mm. longa, tubo 0·5 mm. longo glabro, lobis elliptico-ovatis ad basin linea pilorum laneorum notatis. *Antherae* 0·9–1 mm. longae, basi et ad margines dense villosae, filamentis 1·5 mm. longis in sinubus insertis. *Ovarium* inferne glabrum, in parte superiore et cum stylo pilis erectis instructum; stylus 2 mm. longus, crassus; stigmate capitato. *Fructus* circiter 2-2·5 cm. diametro (*King's Coll.* 6921, *Maingay K.D.* 1035);



Figures in upper row from *Maingay* 1975; those in lower row from *L. Wray* 4279. All the figures are from drawings by Miss M. Smith.

pericarpium laeve, crustaceum, 0·25 mm. crassum. *Semina* 2, circiter 1·3 cm. diametro, orbicularia, plano-subconvexa, compressa; King & Gamble in Mat. Flor. Mal. Penins. iv. p. 824, spec. *King's Collector* 8190 excl. *S. laurina*, Clarke in Hook. f. Flor. Brit. Ind. iv. p. 88, quoad fruct. descr. *S. laurina*, King & Gamble, l.c. p. 825, quoad *Maingay K.D.* 1035.

Malay Peninsula. Perak: Selama; Plains, *Wray* 4279, 3112; Ulu Leding, *Wray* 2009; dense jungle, 30 m., *King's Collector* 6291; *Scortechini* 1026.

Malacca: *Maingay* 1975, 3393 (*K.D.* 1035), 1042.

According to the collector's labels, *S. Maingayi* is a shrubby creeper, 10–15 ft. long. It is an easily recognised plant by its glabrous, highly polished, trinerved leaves and by the numerous small lenticels often transversely split and almost circular in outline. The leaf venation is obscure on the upper surface but fairly evident on the lower side. The fruit is about an inch in diameter, according to the two fruiting specimens assigned to this species. One of these, *Maingay* 3393 (*K.D.* 1035), was included by Clarke under *S. laurina*, Wall., and is the specimen from which the fruits of *S. laurina* in the Flora of British India are described; King & Gamble have accepted Clarke's identification. There can be little doubt, however, that Maingay's Malacca specimen is quite distinct from *S. laurina*, Wall., gathered in Tenasserim.

The Perak plants, especially *Wray* 4279 (see figs.), differ slightly from Maingay's Malacca specimen in the greater development of the anther hairs. The anthers in the Perak plants are densely hairy not only at the base but also all along the margin or line of dehiscence of the anther cells.

Maingay K.D. 1038, on which Clarke founded his doubtful variety *fructuosa* (Flor. Brit. Ind. iv. p. 88), proves to belong to *S. ovalifolia*, Wall.

King's Collector 8190, a fruiting specimen from the Goping District, Perak, cited under *S. Maingayi*, by King & Gamble l.c. is wrongly assigned to that species and should be referred to *S. Curtisii*, King & Gamble. It differs from fruiting specimens of *S. Maingayi* more particularly in the shape of the lenticels, the stouter, more coriaceous leaves with inconspicuous veins, and in the larger fruits.

Curtis 3667, from Penang, has unfortunately not been seen.

6. **S. ovata,** *A. W. Hill* in Kew Bull. 1909, p. 360; descr. emend. et ampl.

Folia trinervia. *Calyx* 0·75-1 mm. longus, segmentis orbiculari-ovatis subacutis marginibus pubescentibus. *Corolla* extra parce pubescens, 3-3·25 mm. longa, lobis glabris 2·25-2·5 mm. longis, tubo 0·75 mm. longo ad faucem tantum laneis hirsutis instructo. *Antherae* 0·75 mm. longae, basi barbatae, filamentis 0·75-1 mm. longis. *Ovarium* ovoideum, superne hirsutum, cum stylo 3 mm. longum; stylus ad basin hirsutus, 1·75 mm. longus. *Fructus* globosus (*Merrill* 9431), 1·7 cm. diametro, 1-2 spermus (?); pericarpium laeve, crustaceum, vernicosum; A. W. Hill in Kew Bull. 1911, p. 295.

Philippine Islands. Palawan 'Paragua,' *Vidal* 3315; Apulit Island; Taytay Bay (May), *Merrill* 9431 (?).

In preparing the original description the beard at the base of the anthers was overlooked and the species is wrongly placed in the key given in *K.B.* 1911, p. 286; it appears to be allied to *S. barbata*, A. W. Hill, though the corolla tube is much shorter. The corolla lobes are glabrous, but there is a dense ring of woolly hairs at the throat of the corolla. The top of the ovary and the base of the style are beset with erect hairs. Merrill's specimen from Apulit Island in Taytay Bay at the N.E. end of Palawan or Paragua almost certainly belongs to *S. ovata;* the flowers unfortunately are immature, but the woolly character of the corolla hairs, the bearded anthers and hairy style can be seen. The fruit is a small globular berry with a thin brown polished pericarp.

Whitford's specimen from Lamao river, in the Province of Bataan, Luzon (in herb. Bur. Sc.) resembles *S. ovata*, especially *Merrill* 9431, but the corollas have fallen, and the fruit is certainly larger.

7. **S. villosa,** *A. W. Hill* in Kew Bull. 1911, p. 296; descr. emend.

Antherae basi paullo barbatae.

Java. Wukau, *Horsfield* 1319; without locality, *Kurz*.

S. villosa and *S. lanceolaris* appear to be closely allied and in both species the corolla is hairy outside; in *S. lanceolaris* however, the corolla is glabrous within while *S. villosa* bears scattered woolly hairs on the corolla lobes. The anthers are slightly bearded at the base and not glabrous as stated in the original description.

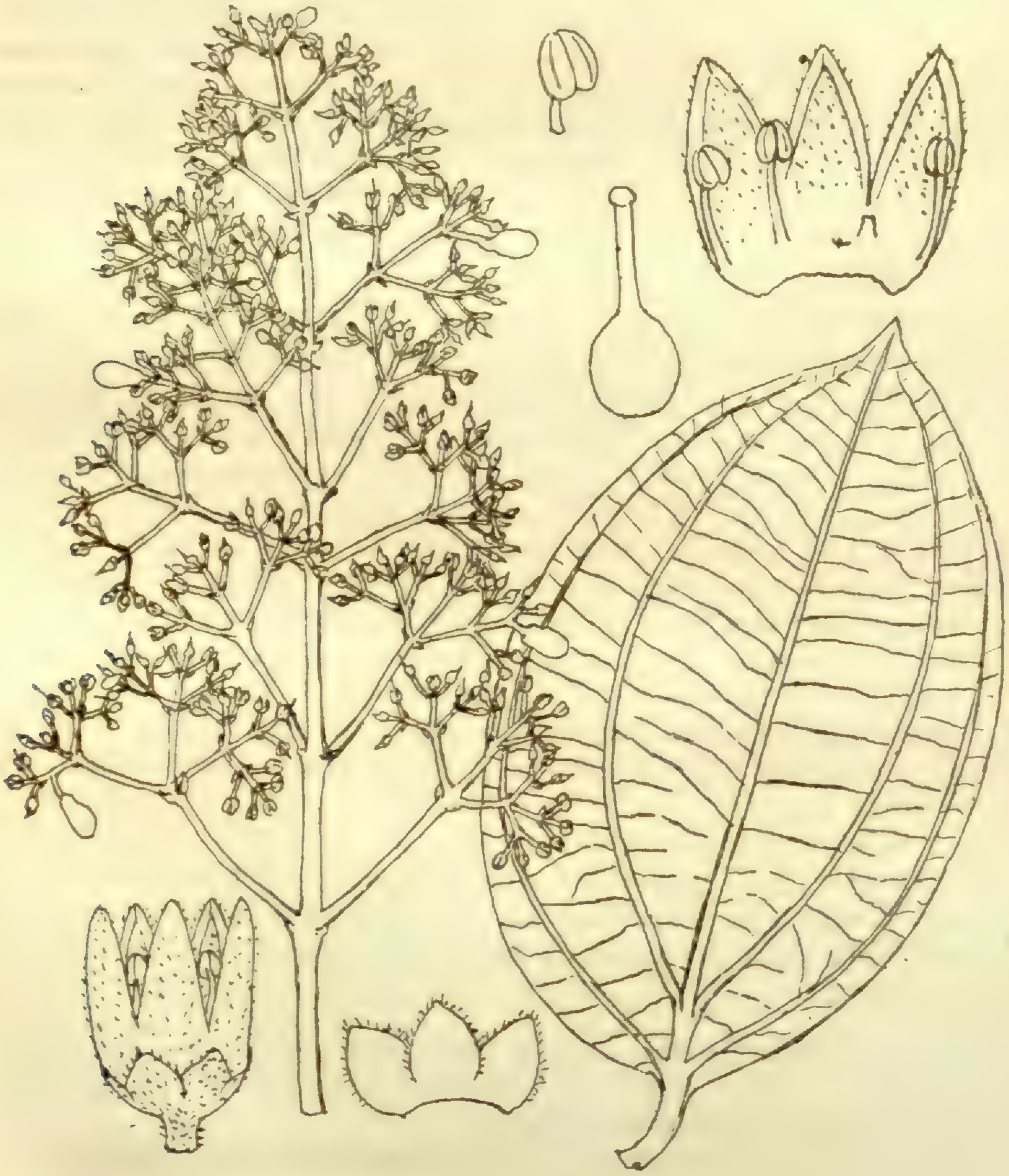
As the flowers are immature it may be that this species really belongs to the section with woolly hairs at the throat and a well-developed corolla tube.

8. **S. lanceolaris,** *Miq.* Flor. Ind. Bat. Suppl. pp. 227, 551, descr. emend.; A. W. Hill in Kew Bull. 1911, p. 295.

SUMATRA. *Korthals* in Herb. Lugd. Bat.; Palembang, *Teysmann.*

9. **S. hirsutiflora,** *A. W. Hill*; species foliis quintuplinerviis, corollae lobis paginae utriusque hirsutis antherisque glabris distincta.

Frutex scandens, 30 m. longus; caulis 8-10 cm. diametro, ramis cortice striato dense ferrugineo-tomentosis. *Folia* ovato-elliptica vel ovata, 7-9 cm. longa vel ultra, 4-4·7 cm. lata, superne



vernicosa, glabra, inferne omnino sparse et ad nervos praecipue ferrugineo-pubescentia, quintuplinervia, venis approximatis conspicuis; petiolis pubescentibus. *Inflorescentiae* axillares vel terminales, laxe paniculatae, multiflorae, 15-30 cm. longae, foliaceae; pedunculis lateralibus 2-3 cm. longis pedunculis pedicèllisque dense ferrugineo-hirsutis. *Calycis* segmenta anguste ovata, acuta vel subacuta, 0·75 mm. longa, pubescentia, marginibus ciliatis. *Corolla* 1·75 mm. longa, lobis triangulari-ovatis acutis 1·25 mm. longis externe et interne parte superiore pilis substrigosis instructis, tubo et fauce glabro. *Antherae* orbiculari-ovatae, 0·4 mm. longae, glabrae, filamentis 0·5 mm. longis in sinubus insertis. *Ovarium* globosum, cum stylo glabrum 1·5 mm. longum. *Fructus* immaturus, pyriformis, 1·3 cm. longus, 7 mm. diametro.

Perak. Mixed forest clinging to a large tree; 120–180 m. (June), *King's Collector* 10311.

The flowers are said to be pale green-yellow. With the corolla lobes hairy on both sides, absence of hairs from the throat and glabrous anthers this species differs considerably from all others known from this region. It is a striking plant with its long loose paniculate inflorescences. The leaves resemble those of *S. malaccensis*, Benth., but the flowers are very different. Though it comes next to *S. bicirrhosa*, Lesch., in the key it may not be nearly allied to this Indian species of which the flowers are only in bud. Mature fruits are unknown for either plant but as regards flowers and leaves they have several characters in common.

In a note under *S. Tieuté*, King & Gamble (Mat. Flor. Mal. Penins. iv. p. 832) state that *King's Collector* 10311 agrees fairly well with the Javan species *S. Horsfieldiana*, Miq., which, however, is quite distinct in having a line of erect hairs across the corolla lobes (see p. 179). *S. hirsutiflora* is no doubt allied to *S. villosa*, A. W. Hill (see p. 143 and *K.B.* 1911. p. 296) which has been confused with *S. Horsfieldiana*.

10. **S. bicirrhosa,** *Lesch.* in Roxb. Fl. Ind. ii. p. 267, descr. ampl.

Frutex scandens, pubescens. *Folia* ovata, rotundato- vel elliptico-ovata, cuspidato-acuta, basi rotundata, 3·5-6 cm. longa, plus minusve 3 cm. lata, superne vernicosa, omnino et ad nervos praecipue minutissime pubescentia, triplinervia; cirrhi bifidi, atque rami pubescentes. *Inflorescentiae* paniculatae, pedunculi et pedicelli dense pubescentes. *Calycis* segmenta triangulari-ovata, acuta, 0·75 mm. longa, marginibus fimbriatis. *Corolla* externe hirsuta, alabastro 2·5 mm. longo, tubo 0·5 mm. longo glabro, lobis intus pilis laneis obtectis. *Antherae* ovatae, glabrae, 0·65 mm. longae, filamentis 0·65 mm. longis. *Ovarium* cum stylo 0·5 mm. longum, glabrum. *Fructus* immaturus (ex *Lesch.*) globosus, monospermus; G. Don. Dict. iv. p. 66; Grah. Cat. 1839, p. 112; A. DC. in DC. Prodr. ix. p. 16. *S. colubrina*, C. B. Clarke in Hook. f. Flor. Brit. Ind. iv. p. 87; Benth. in Proc. Linn. Soc. i. p. 101; Watt, Dict. Econ. Prod. Ind. vi.

pt. iii. p. 378; Cooke Fl. Bombay, ii. p. 184; Dop in Bull. Soc. Bot. Fr. lvii. Mém. 19 (1910), p. 14 omnes quoad *S. bicirrhosa*, Lesch.

S. India. Koudracotta: about 20 m. south of Tanjore; in the forests, *M. Leschenault* (1820) *in herb. Wallich* 1589 (1).

S. bicirrhosa, Lesch., is a perfectly good and distinct species. It differs from *S. colubrina*, the species of the Malabar coast, in being covered with a minute pubescence both on stems and leaves; the triplinerved leaves, acute calyx segments, hairy corolla lobes and glabrous ovary and style also constitute important distinguishing features. Unfortunately the flowers of the single specimen are only in bud, and there is therefore uncertainty as to the ultimate size of the flowers and length of the corolla tube.

Wallich, no doubt by accident, has put down the locality on the sheet as "Nilghirries" but the spot where it was found is quite away from that region and no other specimens of *Strychnos* appear to have been collected there.

11. **S. vitiensis,** *A. W. Hill* in Kew Bull. 1911, p. 295; *S. colubrina*, Seeman, Flor. Vit. p. 166 non Linn.; descr. emend.

Corollae lobi intus glabri vel pilis paucissimis instructi.

Fiji Islands. Viti Levu. *Seeman* 302; *Milne* 64.

The leaves are markedly tripli- or almost quintupli-nerved and the nerves and reticulate veins are prominent on both surfaces. The lobes of the corolla are usually glabrous but a very few hairs are found occasionally on the inner surface.

12. **S. hypogyna,** *C. B. Clarke* in Hook. f. Flor. Brit. Ind. iv. p. 86; descr. ampl.

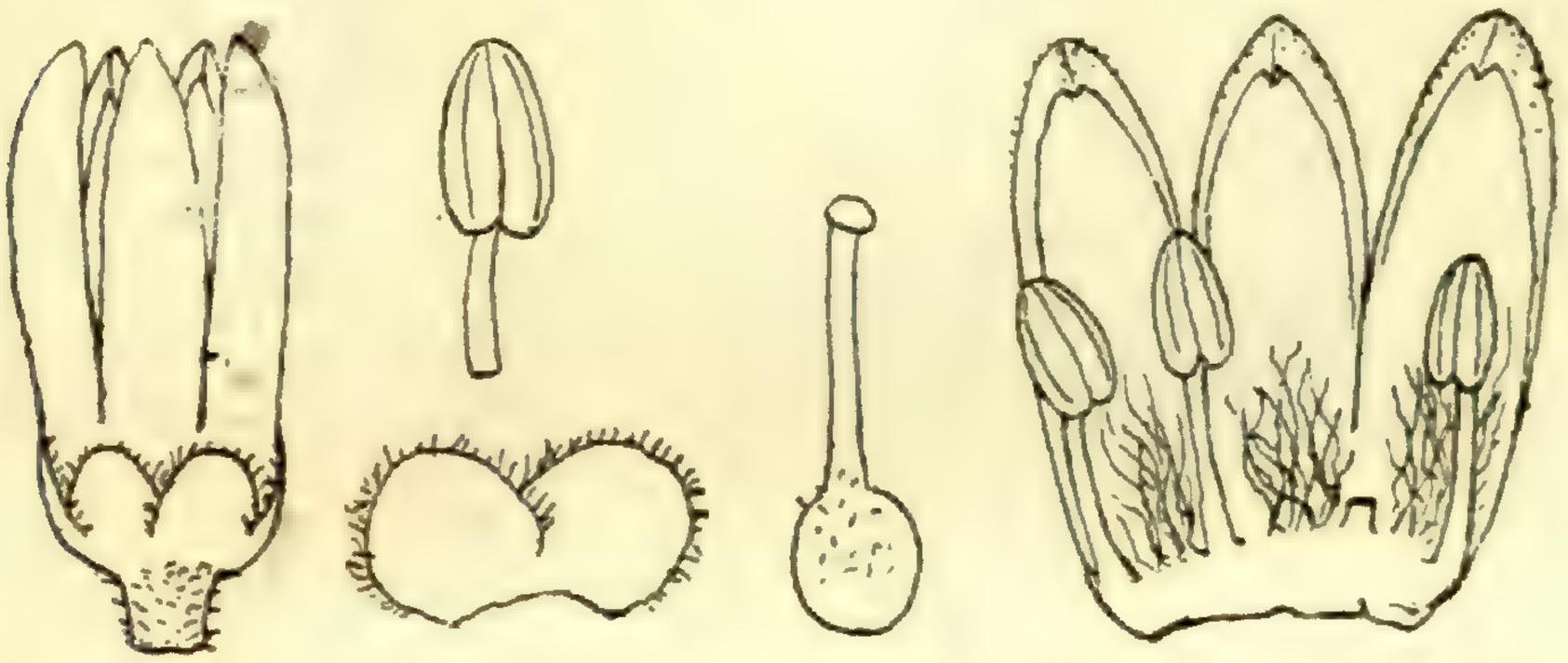
Folia triplinervia vel sub-triplinervia, acuminata, supra vernicosa. *Inflorescentia* paniculata, multiflora, 4-5 cm. longa, pedunculis rufo-pubescentibus, cymis ultimis 3-floris, pedicellis brevissimis. *Calycis* segmenta brevia, obtusa. *Corolla* 2-2·5 mm. longa, lobis intra laneo-tomentosis, tubo 0·4 mm. longo ad faucem tomentoso. *Antherae* 0·8 mm. longae, glabrae, filamentis 0·5 mm. longis. *Ovarium* superne pilis erectis instructum, cum stylo breve 1 mm. longum; Brandis, Indian Trees, p. 474.

Tenasserim. Mergui (?), *Herb. Griffith, K.D.* 3830.

In the Flora of British India the distribution of this species is extended to Borneo, and Clarke appears to have regarded a specimen collected by *Motley* (no. 902) as belonging to this species. This Bornean plant, however, has bearded anthers and is taken to be identical with *S. laurina*, Wall. (see p. 150).

13. **S. andamanensis,** *A. W. Hill;* species *S. hypogynae*, C. B. Clarke, affinis, floribus majoribus, calycibus extra glabris, stylo conspicuo praecipue differt.

Frutex scandens. *Folia* late-elliptica vel ovato-elliptica, basi rotundato-cuneata vel cuneata, apice acuminata, 11-14 cm. longa, 4·5-7 cm. lata, nervis 3-5, plus minusve triplinervia, superne vernicosa, glabra, nervis pagina inferiore sparse strigoso-hirsutis vel subglabris; petiolis circiter 5 mm. longis. *Inflorescentiae* axillares, paniculatae, 2·5-5 cm. longae, pedunculis parce rufo-pubescentibus, bracteis ovatis concavis acutis glabris, pedicellis circiter 2 mm. longis. *Calycis* segmenta 1 mm. longa, ovato-orbicularia, subacuta, glabra, marginibus fimbriatis.



Corolla 4·5-5 mm. longa, tubo 0·75-1 mm. longo, lobis ellipticis ligulatiformibus subacutis ad basin pilis longis laneis sparse instructis. *Antherae* 1 mm. longae, glabrae, filamentis 2·5 mm. longis. *Ovarium* cum stylo 5 mm. longum, glabrum vel subglabrum. *Fructus* globosus, glaber, circiter 1·8-2 cm. diametro, 1- (2?) spermus; pericarpium tenue, coriaceum. *Semina* orbicularia, plano-subconvexa, circiter 1 cm. diametro. *S. acuminata*, C. B. Clarke in Hook. f. Flor. Brit. Ind. iv. p. 86, quoad spec. ***Kurz*** tantum; Kurz For. Flor. ii. p. 166 et Brandis, Indian Trees, p. 474, quoad spec. Andaman. tantum; Prain, Proc. Asiatic Soc. Bengal, 1891. p. 170, non Prain in Journ. Asiatic Soc. Bengal. lxii. pt. ii., 1893, p. 73. *S. laurina* (?), Kurz. Rep. Veg. Andam. Is. 1870, p. 43.

S. Andaman. Port Mouat, *Kurz*; Hobdaypore, *King's Collector; Prain's Collector; Heinig* 224, 410; Andamans, *Herb. R.E.P.* 12146.

Nicobar. *Jelinek* 159 (exped. Novara); Nicobar Island, *King's Collector* 521; Batti Malve, *Prain* (March. 1891).

This is a well marked species with its long ligulate perianth lobes and glabrous anthers borne on long filaments. The leaves are usually cuneate at the base. and the nerves on the under-surface are furnished with some brown strigose hairs.

Specimens have been collected in the Andamans, Nicobar Island and the Island of Batti Malve lying between the two groups. This latter plant is rather more hairy than the other specimens and bears no flowers, but should almost certainly be referred to this species.

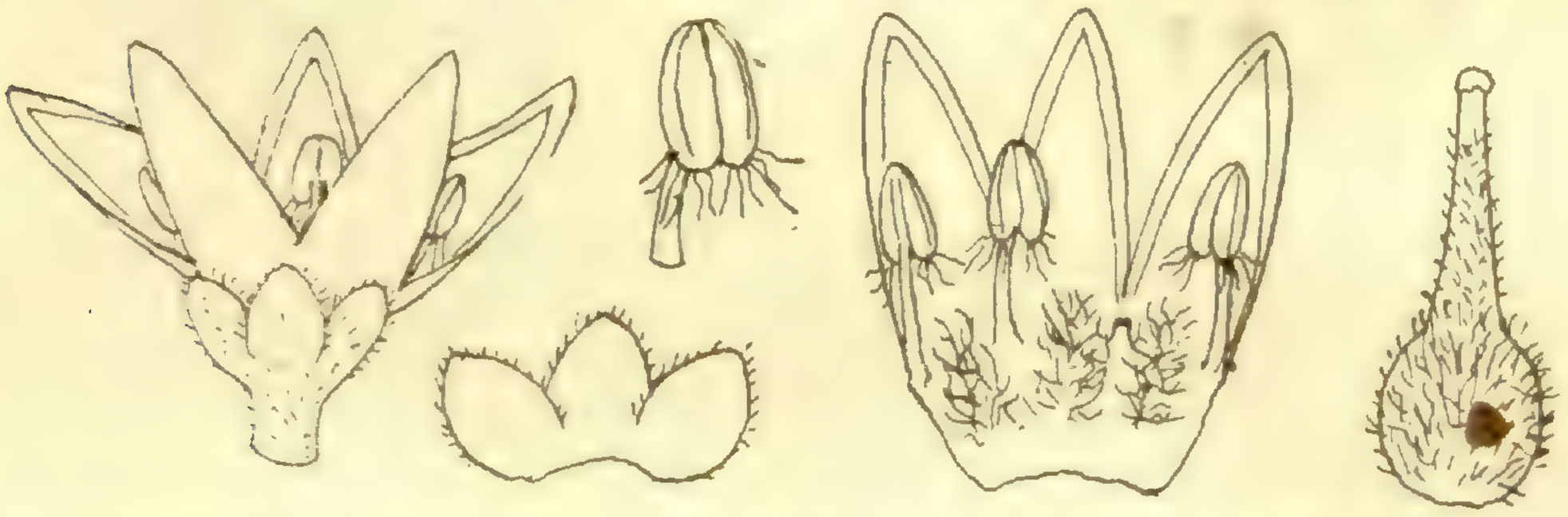
A species of *Strynchnos* collected by Prain on the isolated island of Narcondam was referred by him to *S. acuminata*, Wall. It consists of leaves only, which are ovate-lanceolate gradually acuminate and trinerved. The young stems, petioles, and the

nerves on the under surface of the leaf are markedly rufous-tomentose. The plant appears to be a distinct species, and has been described under the name *S. narcondamensis* (see p. 203).

There is also a leaf specimen from the Nicobars collected by *Kurz* in 1875 (no. 26101), preserved at Kew which is unlike any other known species from these Islands or from the Andamans.

14. **S. panayensis,** *A. W. Hill*; species *S. ovatae*, A. W. Hill, affinis, foliis elliptico- vel ovato-lanceolatis triplinervibus venis inconspicuis, antheris majoribus conspicue barbatis praecipue differt.

Frutex glaber, cortice striato. *Folia* elliptico- vel ovato-lanceolata, 8-11 cm. longa, 2·5-5·5 cm. lata, acute acuminata, apiculata, basi rotundato-cuneata vel cuneata, glabra, superne vernicosa, venis inconspicuis, 5-nervia, triplinervia; petioli 0·5-1 cm. longi. *Inflorescentiae* axillares vel terminales, corymboso-paniculatae, 3 cm. longae, pedunculis pedicellisque



minutissime pubescentibus. *Calycis* segmenta 1 mm. longa, triangulari-ovata, acuta, marginibus ciliatis. *Corolla* 3·5 mm. longa, ad faucem pilis laneis instructa, lobis lanceolatis reflexis 2·5-2·65 mm. longis, glabris. *Antherae* 1·25 mm. longae, basi barbatae, filamentis 0·5 mm. longis. *Ovarium* conicum, cum stylo dense hirsutum 3-3·5 longum.

Philippine Islands. Panay; Capiz, *L. Escritor, Bur. Sci. No.* 21232—(Fl. June).

This is up to the present the only species of *Strychnos* known from the Island of Panay. The hairy flask-shaped ovary and bearded anthers distinguish it from other short-tubed species with triplinerved leaves. *S. panayensis* agrees with *S. ovata*, A. W. Hill, in the character of the anthers and ovary, but is easily distinguished by its leaves and larger, more densely bearded anthers.

Section ii. **Lanigerae.**

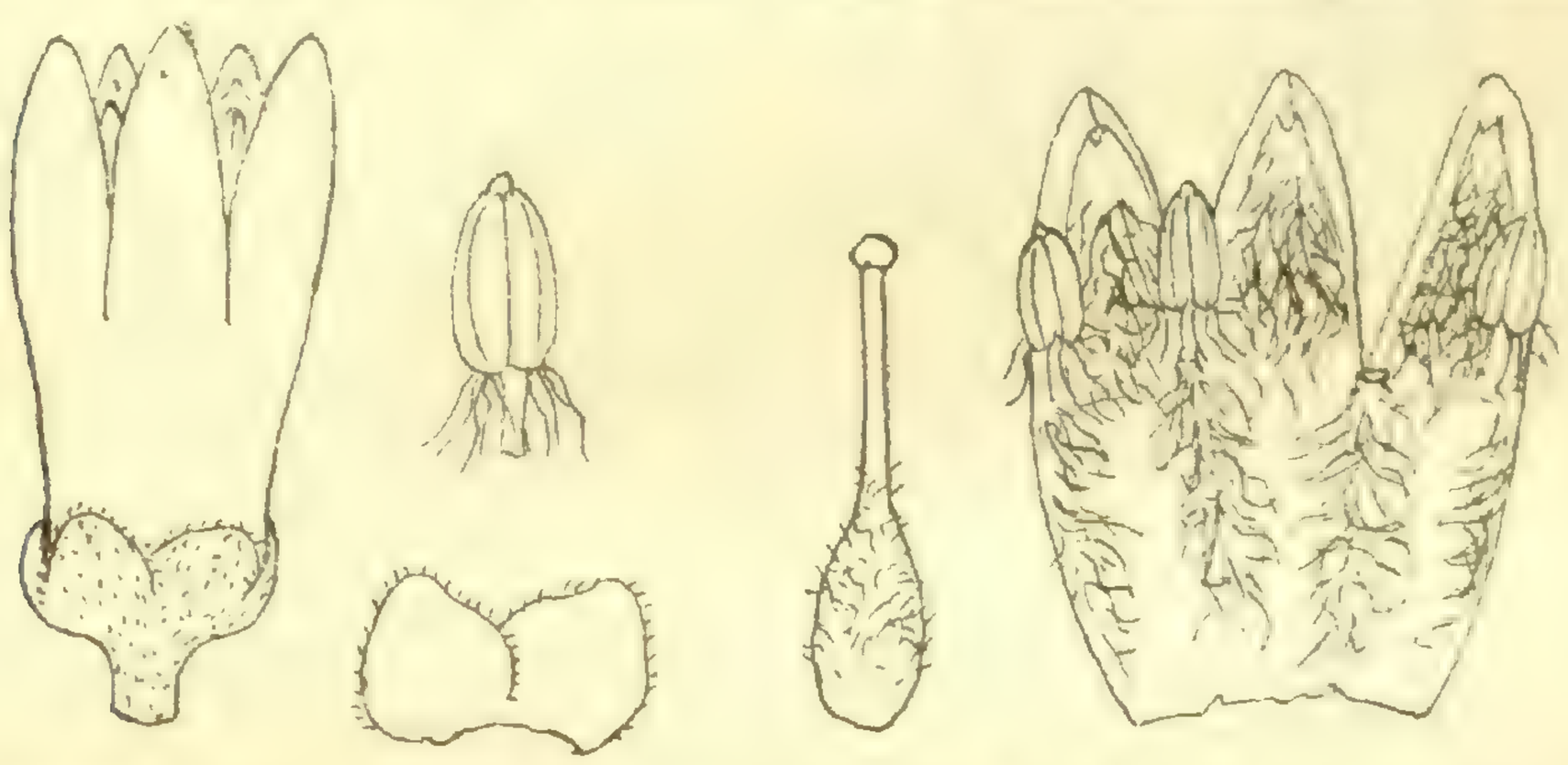
15. **S. cinnamophylla,** *Gilg et Benedict* in Engl. Bot. Jahrb. liv. p. 166.

New Guinea. Kaiser-Wilhelmsland; woods near the Djamu-Klamm, 400 m., *Schlechter* 16793—(Fl. Nov).

The anthers are bearded at the base, and the ovary hairy. The throat hairs are very few and short. It may be nearly allied to *S. Forbesii*. A. W. Hill, but nothing definite can be said in the absence of fruits. The specimen has not been seen.

16. **S. septemnervis,** *C. B. Clarke* in Hook. f. Flor. Brit. Ind. iv. p. 88, descr. emend. et ampl.

Suffrutex scandens, caulibus 30 m. longis vel longioribus, 7-15 cm. in diametro, lenticellis ovalis instructis. *Folia* elliptica vel elliptico-ovata, basi attenuata, apice sensim acuta, coriacea, superne vernicosa, 5- vel obscure 7-nervia, triplinervia, 8-12 cm. longa, 4·5-6 cm. lata; petiolis 1 cm. longis. *Inflorescentiae* axillares, paniculatae, multiflorae, circiter 10 cm. longae; pedunculis pedicellisque pubescentibus. *Calyx* 1 mm. longus, segmentis rotundato-ovatis glabris marginibus ciliatis. *Corolla* 5 mm. longa, lobis 2·5 mm. longis pilis laneis plus minusve



transverse lineatim dispositis tuboque pilis laneis longitudinaliter dispositis dense instructis. *Antherae* oblongae, 1 mm. longae, basi plus minusve barbatae, filamentis 0·5-0·75 mm. longis hirsutis vel subglabris partibus tubo adnatis dense hirsutis. *Ovarium* cum stylo 4·5 mm. longum, pilis erectis instructum. *Bacca* immatura ovoidea, monosperma; pericarpium laeve, crustaceum; King & Gamble, Mat. Flor. Mal. Penins iv. p. 829 quoad spec. *Maingay* 1036. *S. Curtisii,* King & Gamble, Mat. Flor. Mal. Penins. iv. p. 824, partim.

Malay Peninsula. Perak: Ulu Bubong; jungle—clinging to large trees, 120-180 m., July, *King's Collector* 10281: 10438; without precise locality, *Maingay* 3031, 3051 (*K.D.* 1036).

Var. **imberbis,** *A. W. Hill*, foliis apice acuminatis, inflorescentiis minoribus pedunculis pedicellisque glabris vel minutissime pubescentibus, corollae tubo sparse hirsuto, antheris filamentisque glabris praecipue differt. *S. septemnervis*, King & Gamble, Mat. Flor. Mal. Penins. iv. p. 829, partim.

Malay Peninsula. Penang: Penara Bukit, Oct., *Curtis* 1021.

The corolla lobes near their base bear a dense tuft of long hairs arranged more or less in a transverse line. The throat is almost free from hairs, but the tube is densely hairy, usually in lines, which follow the adnate anther filaments.

The anthers are bearded at the base and the filaments are usually hairy. In the variety from Penang the corolla hairs are everywhere much fewer than in the species and the anthers are without beards.

The leaves both in the type and variety resemble those of *Cinnamomum* and with their relatively long petioles enable *S. septemnervis* to be easily recognised.

17. **S. Forbesii,** *A. W. Hill* in Kew Bull. 1909, p. 360; descr. emend. et ampl.

Folia ovato-elliptica, basi rotundato-caudata, apice acuta vel subacuta, 14-20 cm. longa, 6-7·5 cm. lata, tripli- vel subtriplinervia, superne vernicosa, glabra. *Inflorescentiae* axillares, paniculatae, 9-10 cm. longae, pedunculis glabris pedicellis glabris vel pauce pilosis. *Calycis* segmenta late ovata, subacuta vel obtusa, 1·25 mm. longa, marginibus exceptis glabra. *Corolla* 4 mm. longa, lobis 2·25 mm. longis reflexis parte superiore glabris ad faucem pilis laneis instructis, tubo glabro. *Antherae* ovoideae, 1-1·25 mm. longae, basi barbatae, filamentis 0·5 mm. longis in sinubus insertis. *Ovarium* cum stylo 3 mm. longum; stylus ad basin parce hirsutus. *Fructus* (spec. *H. O. Forbes* in herb. Mus. Brit. sine numero) 10 cm. diametro; pericarpium 8 mm. crassum; semina plurima, parva, subtrigona; A. W. Hill in Kew Bull. 1911, p. 295.

New Guinea. Sogeri Region; central position, *H. O. Forbes* 216, 230 in herb. Lugd. Bat., herb. Kew et herb. Mus. Brit.

An examination of the good specimens preserved at Leiden and the British Museum has necessitated some emendations of the original description. *S. Forbesii* appears to be closely allied to *S. barbata*, A. W. Hill. The flowers of *S. Forbesii* first examined were only in the bud stage and the character of the corolla hairs was in consequence not apparent. The hairs are woolly and form an irregular ring at the corolla throat and not a regular line as might be inferred from the description in *K.B.* 1909, p. 360.

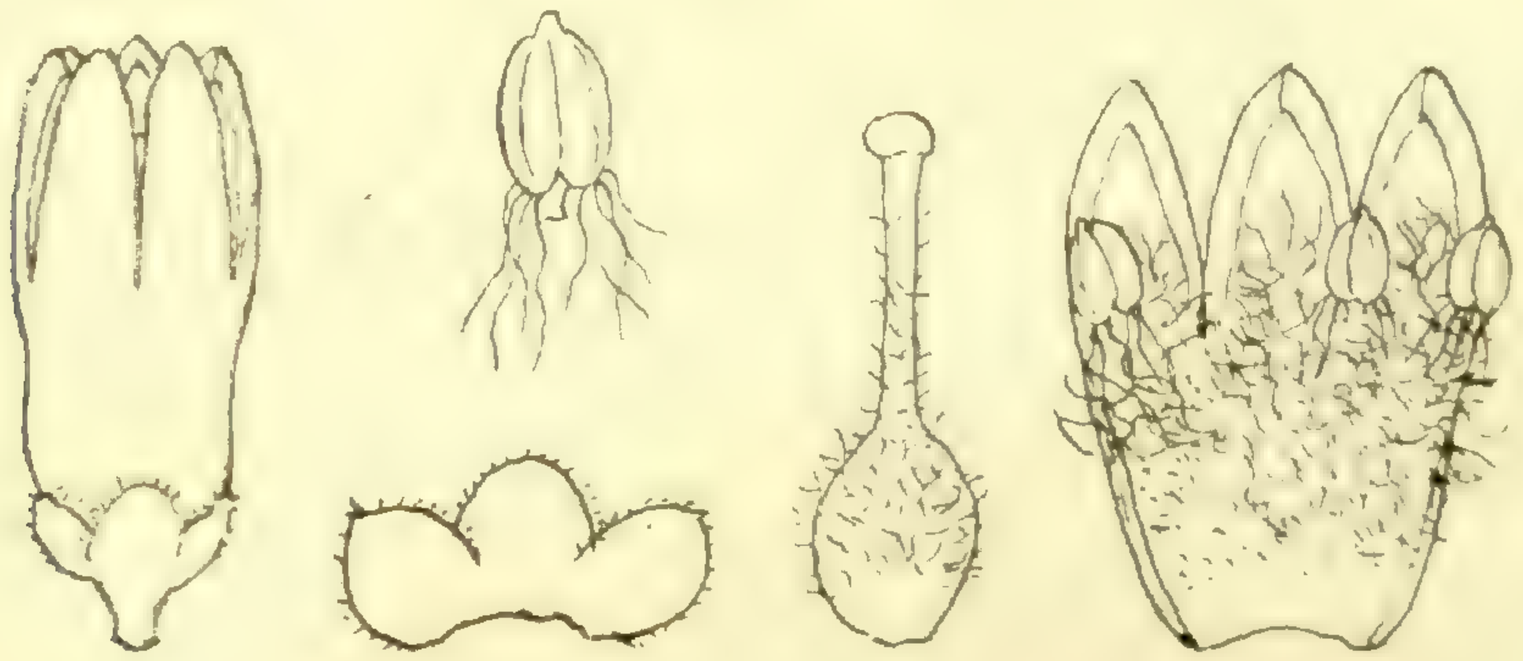
In *K.B.* 1911, p. 286, the species is wrongly placed in the key owing to the mistake as to the hairiness of the corolla. Its position is next to *S. barbata*, A. W. Hill, and from its flowers it appears to be related to *S. laurina*, Wall.

There are fruits preserved at the British Museum collected by Forbes in precisely the same region as his flowering specimens. Unfortunately they bear no number. They are remarkable for their size and thick pericarp, with relatively small seeds. If, as seems highly probable, they are the fruits of *S. Forbesii*, it is evident that it must be a very distinct species.

18. **S. laurina,** *Wall.* Cat. 1591; A. DC. in DC. Prod. ix. p. 13; descr. ampl.

Folia 10-16 cm. longa, 4-8·5 cm. lata, plus minusve triplinervia, lanceolata vel ovato-lanceolata, acuminata, basi cuneata vel rotundato-cuneata, glabra. *Inflorescentiae* axillares vel terminales, paniculatae, 10-15 cm. longae, multiflorae; pedunculis pedicellisque pubescentibus. *Calycis* segmenta orbicularia, 1 mm. longa, marginibus fimbriatis. *Corolla* circiter 5 mm. longa, lobis 2·25-2·5 mm. longis reflexis, versus basin et tubo ad faucem lano-hirsutis. *Antherae* 0·6-1 mm. longae, exsertae, basi paullo barbatae, filamentis 0·5-0·7 mm. longis in sinubus insertis. *Ovarium* cum stylo 3·5-3·75 mm. longum, pilis erectis dense hirsutum. *Bacca* immatura, ovoidea (*Helfer* 3724), circiter 2 cm. longa, monosperma (?); pericarpium membranaceum;

Griffith, Notulae, iv. p. 83; Benth. in Journ. Linn. Soc. i. p. 102; Kurz. For. Flor. ii. p. 166; C. B. Clarke in Hook. f. Flor. Brit. Ind. iv. p. 88, syn. *S. ovalifolia*, Wall. et fruct. descr. excl.; King & Gamble, Mat. Flor. Mal. Penins. iv. p. 825 dubie fruct. descr., *Maingay K.D.* 1035 et *Ridley* 2161 (?) excl.;



Brandis, Indian Trees, p. 475; Dop in Bull. Soc. Bot. Fr. lvii. Mém. 19 (1910), p. 16 et in Lecomte, Flor. Gén. Ind.-Chin. iv. p. 166, spec. Indo-Chin. excl.; A. W. Hill in Kew Bull. 1911, p. 297. *S. acuminata*, Wall. Cat. 1593 no. 1; A. DC. in DC. Prodr. ix. p. 14 partim, quoad 'Amherst' spec. tantum et var. excl.; C. B. Clarke in Hook. f. Flor. Brit. Ind. iv. p. 86 quoad *Wallich* 1593. no. 1 et *Helfer* tantum; Kurz in For. Flor. ii. p. 166 et Braudis, 'Indian Trees' p. 474 quoad spec. Tenasserim tantum. *S. colubrina*, Wall. Cat. 4455 (*Koenig*) partim sub *S. Beddomei*. C. B. Clarke in Hook. f. Flor. Brit. Ind. iv. p. 88.

Burma. Tenasserim: Tavoy, *W. Gomez in Herb. Wallich* 1591; Thanna Hill, *Shaik Mokim* 336; *Amherst* (11. 2. 1827), *Wallich* 1593 no. 1; Mergui, *Griffith* 191 *K.D.* 3729); Mergui (?), *Griffith*, *K.D.* 3727; Mergui Island, *Helfer*, *K.D.* 3727; Domel Is., *Helfer*, *K.D.* 3727; without precise locality (fruiting spec.) *Helfer*, *K.D.* 3724, 3728; without precise locality *Koenig** 4455 in herb. Wallich partim.

Malay Archipelago. Borneo: Bangarmassing, *Motley* 902 (?). There are also specimens, both at Kew and Leiden, from plants cultivated at Buitenzorg, collected by Teijsman, which apparently should be referred to *S. laurina*.

Var. **Thorelii**, *A. W. Hill; Folia* anguste ovato-lanceolata, glabra, basi et apice cuneata 7·5-10 cm. longa, 3·5 cm. lata, trinervia. *Inflorescentiae* paniculatae, 3-4 cm. longae, pubescentes. *Calycis* segmenta rotundata, marginibus fimbriatis. *Corolla* 4 mm. longa vel longior (?) ad faucem et tubo parte superiore pilis laneis dense instructa, lobis glabris acutis 2·5 mm. longis. *Antherae* 1·5 mm. longae, basi dense et longe barbatae. *Ovarium* inferne glabrum; stylus 2 mm. longus cum ovario ad apicem dense hirsutus. *S. laurina*. Dop in Bull. Soc. Bot. Fr.

* Koenig went to Malacca and Siam in August, 1778, and returned to India in 1779 (see Lasègue Mus. Bot. Delessert, p. 557); it is probable that his specimen of *S. laurina* came from near Bat-buri on the Siamese border of Tenasserim.

lvii. Mém. 19 (1910), p. 16 et in Lecomte, Flor. Gén. Ind.-Chin. iv. p. 166, quoad spec. Cochchin.

Cochin-China. Bienhoa: *Thorel* 1064; Ti-tinh, *Pierre*, 6303 in herb. Mus., Paris.

The Cochin-China specimens collected by Thorel and Pierre are no doubt nearly allied to *S. laurina*, Wall., but differ in the leaves, the larger and more hairy anthers, and in the ovary being glabrous, except at the apex.

S. ovalifolia, Wall., included by Clarke under *S. laurina*, is a distinct species belonging to the long-tubed section of the genus (see p. 201). Under *S. laurina*, Clarke, and also King and Gamble, include Maingay's Malacca specimen no. 3393 (*K.D.* 1035). Unfortunately there are no flowers, but the lenticels on the stems, the trinerved leaves with long acuminate tips and the fruits agree with those of *S. Mainguyi*, Clarke, and the specimen has been placed under that species. The other plant placed by them under *S. laurina* is *Ridley* 2161 from Pahang; the flowers are only in bud and resemble those of *S. laurina*, but the leaves do not quite agree.* Another doubtful specimen is that collected by *R. L. Keenan*, at Shapore, Cachar; the specimen bears buds only and no hairs can be detected on the flowers.

Whether *S. laurina* ranges into Indo-China, as Dop states, is uncertain in the absence of complete specimens, but from that region the plants appear to be very near to the type and are therefore considered as a variety.

Helfer 3728 is placed by Clarke (l.c.) under *S. acuminata*, and by Dop under *S. laurina*. It is undoubtedly *S. laurina* with the flowers in bud only, and was collected not in the Andamans but in Tenasserim.

S. acuminata, Wall. Cat. 1593 in part (collected at Amherst), is a leaf specimen only (see A. DC. in DC. Prod. ix. p. 14, excluding specimen *b* and the variety) but should no doubt be referred to *S. laurina*.† Bentham (Journ. Linn. Soc. i. p. 103), suggests that *S. acuminata* should be referred to *S. ovalifolia*, Wall.

Reference has already been made to the Wallichian sheet 4455 b. (see pp. 151 & 158) referred to by Clarke under *S. Bed-*

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* The specimens referred to by King & Gamble, l.c. p. 826, in the footnote to *S. laurina* have been described as a new species *S. quadrangularis* (see p. 205).

† With regard to the two other Wallichian specimens bearing the number 1593, considerable confusion has arisen owing to the labelling of No. 2 with the letter *a* and No. 3 with the letter *b* on the Wallichian sheet. C. B. Clarke has assigned both Nos. 1 and 3 *b* (= var. *c.* of A. DC. from Atrau) to *S. acuminata*, but No. 2 *a* he has referred to *S. rufa*, var. *Candollei*, and being perhaps mislead by the subsequent lettering of Wallich's specimens, has made De Candolle's *S. acuminata*, a synonym of this variety.

Of these three Wallichian specimens, No. 1 only belongs to *S. laurina*. No. 2, which consists of three pubescent leaves and a piece of stem, may be related to *S. rufa*, C. B. Clarke. No. 3, also a leaf specimen, with large, coarsely-veined leaves is *S. Nux-blanda*, A. W. Hill (see p. 189).

domei. The upper flowering specimen undoubtedly belongs to *S. laurina*, but the lower one is *S. colubrina* from S.W. India.

Like some other Malayan plants, *S. laurina* may also occur in Borneo, if the somewhat imperfect specimen *Motley* 902 is rightly assigned to this species.* The flowers, however, are in bud and the specimen cannot be determined with any certainty.

The Javan specimens appear to be all taken from cultivated plants, and we have no evidence that *S. laurina* is indigenous in the island. Brandis (Indian Trees, p. 475), extends the distribution to the Nicobars, but if he had in mind *Kurz* 26101, an immature specimen, he is certainly incorrect. Such a distribution also is not very probable.

The description of the fruit given by Clarke (Flor. Brit. Ind. iv. p. 88), is based on *Maingay K.D.* 1035 from Malacca, which proves to be *S. Maingayi*, Clarke. The description, and that given by King & Gamble l.c., which is also taken from the same specimen, must therefore be disregarded.

The only fruiting specimen of *S. laurina* at Kew or Calcutta is *Helfer* 3724, and Kurz's description—"berries oval, about an inch long, with a membranous skin, containing a single large seed conform with the berry"—is no doubt based on this specimen (For. Flor. ii. p. 166). The fruits however are not fully mature and their structure cannot properly be determined.

19. **S. similis,** *A. W. Hill* in Kew Bull. 1912, p. 38; descr. emend.; species *S. laurinae*, Wall. et *S. barbatae*, A. W. Hill. affinis, sed ab ambabus antheris fusco-viridibus, foliis anguste elliptico-lanceolatis praecipue differt.

Folia conspicue triplinervia vel quintuplinervia. *Corolla* 5·5 mm. longa, lobis 2·75 mm. longis inferne et corollae fauce hirsutis. *Antherae* 1 mm. longae, fusco-virides, basi barbatae; filamentis 0·75 mm. longis. *Ovarium* globosum, 1 mm. diametro, hirsutum; stylus 3·5 mm. longus, basi hirsutus.

Philippine Islands. Mindanao: Prov. Surigao; Hinatuan. *C. V. Piper*, 504.

In the original description the size of the anthers was omitted and by a misprint the diameter of the ovary was given as 8 mm. instead of 1 mm. The paniculate inflorescences are some 8-10 cm. long and 7 cm. in breadth. *S. similis* was compared with *S. multiflora* and *S. lanata*, but in its triplinerved leaves, bearded anthers and hairy ovary it resembles *S. barbata*, A. W. Hill, and *S. Forbesii*, A. W. Hill from New Guinea, and also *S. laurina*, Wall., from Burma and Malaya. The leaves are 5-nerved, the intermediate pair branching off from the mid-rib some 1·5-2 cm. above the base of the leaf.

20. **S. barbata,** *A. W. Hill* in Kew Bull. 1909, p. 359; Kew Bull. 1911, 297. *Sirioides*, Rumph. Herb. Amb. v. p. 50 (?)

New Guinea. Soron: Olandite, *Beccari* 98.

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* This specimen appears to be referred to in Hook. f. Flor. Brit. Ind. iv. p. 86, under *S. hypogyna*, C. B. Clarke.

Amboina. Amahoesoe: on cliffs 6 m. alt. *C. B. Robinson* 2028.

According to E. D. Merrill, from whom the Amboina specimen was received, this species probably represents Rumphius' *Sirioides* which has not previously been identified.

The broadly elliptical leaves in the Amboina plant measure as much as 16 cm. long by 9·5 cm. broad. They are conspicuously triplinerved, and there are five well-marked veins. The corolla measures 6 mm., the tube being equal in length to the lobes. The anthers are 1-1·25 mm. long, and the filaments, which measure 1·75-2 mm. in length, carry the anthers to the top of the corolla lobes. In the New Guinea specimen the length of the corolla is only about 4·5 mm., but there seems very little doubt that both specimens should be referred to *S. barbata*.

21. **S. potatorum,** *Linn. f.* Suppl. p. 148; descr. ampl.

Inflorescentiae axillares, pedunculis pedicellisque glabris *Calyx* glaber. *Corolla* 6·5-7 mm. longa, lobis 3-3·5 mm. longis fauceque pilis sparsis instructis. *Antherae* 1 mm. longae, glabrae filamentis 1·5-1·75 mm. longis in sinubus insertis. *Ovarium* cum stylo glabrum, 6 mm. longum; G. Don, Dict. iv. p. 65; A. DC. in DC. Prodr. ix. p. 15 (lit. cit.); Wight, illustr. ii. t. 156; Benth. in Journ. Linn. Soc. i. 103; C. B. Clarke in Hook. f. Flor. Brit. Ind. iv. p. 90 (lit. cit.); Kurz, For. Flor. ii. p. 167; Cooke, Fl. Bombay, ii. p. 186; Dalz. & Gibs. Bombay Flora, p. 156; Wall. Fl. Ind. ii. p. 263; Roxb. Fl. Ind. i. p. 576; Thwaites, Enum. Plant. Zeylan. p. 425 non p. 201; Trimen, Fl. Ceylon, Pt. iii. p. 176; Brandis, Indian Trees, p. 474; Dop in Bull. Soc. Bot. Fr. lvii. Mém. 19 (1910), p. 18; Bourdillon, Forest Trees, Travancore, p. 270.

Ceylon. Doonbera; Trincomalee, *Glenie C. P.* 3719; without locality, *Koenig* in herb. Mus. Brit.

S. India. Deccan peninsula: Mysore to Chotanagpur; numerous collectors.

Burma. Prome Hills, *Wallich* 1585; Pegu, Prome, *Kurz* 2320; Prome, *Burkill* 23819 in herb. R. E. P.

The inflorescences are borne at the end of short, leafy, axillary shoots. The long flowers resemble externally those of the long-tubed species, but the corolla lobes are almost equal in length to the tube. The mature leaves are quintuplinerved and easily recognized from those of any other eastern species. Some specimens from Courtallum in herb. Wight (1836 no. 639) at Glasgow have obovate leaves cuneate at the base, and the twigs are unusually slender. The tree is characteristic of the dry regions of India and Ceylon and the only record of its occurrence in Burma is from the Prome Hills, where conditions resemble those of the drier parts of India. As the tree bears no native Burmese name it seems possible that it may have been introduced from India.

The Burma material is very poor, no flowers being present, but

the seed appears to be rather larger than in the Indian specimens. Kurz's description also differs slightly from that given in the Flora of British India.

22. **S. flavescens,** *King & Gamble* in Mat. Flor. Malay Penins. iv. p. 827; descr. ampl.

Folia trinervia. *Calycis* segmenta orbicularia-ovata, rotundata, ciliata. *Corolla* externe minute hirsuta, 2·5 mm. longa, lobis 1 mm. longis elliptico-ovatis acutis intus et ad faucem dense laneo-hirsutis. *Antherae* 0·5 mm. longae, glabrae vel subglabrae inter pileos occultae, filamentis 0·5 mm. longis. *Ovarium* globosum, glabrum; stylus 0·65 mm. longus, pilis erectis instructus. *Fructus* ovoideus, 1·8 cm. longus, monospermus; pericarpium tenue. *Semen* 1·6 cm. longum, planum.

Malay Peninsula. Perak: Larut; rocky local open jungle, 150-250 m. (Oct.), *King's Collector* 4998 in herb. Calc.; *Scortechini* 1498. Penang: Waterfall, *Curtis* 3430; Waterfall (Sept. 1901, fruit) *Curtis*. Malacca: Ayer Panas, *Curtis* 3490.

Other specimens are quoted by King and Gamble, but those mentioned are the only representatives at Kew. *Curtis* 3430 is a fruiting specimen, and the description of the fruit is fully given in the 'Materials' but the hairiness of the style is not mentioned. The specimen from Perak is described as a shrubby creeper 30-40 ft. long, with leaves of a light yellowish-green colour; this leaf colour is very noticeable in all the dried specimens.

23. **S. coriacea,** *Thwaites*, Enum. Plant. Zeyl. p. 425; descr. ampl.

Frutex ramulis junioribus pubescentibus. *Folia* ovato- vel elliptico-lanceolata, acuta vel breviter acuminata, coriacea, 6-6·5 cm. longa, circiter 3 cm. lata, marginibus paullo reflexis, subtriplinervia, nervibus crassis, petiolis 2 mm. longis hirsutis. *Inflorescentiae* axillares, crassae, 3·5-4 cm. longae, pedunculis pedicellisque pubescentibus. *Calyx* 1·5 mm. longus; segmenta late ovata, subacuta, marginibus ciliatis. *Corolla* 6 mm. longa, externe puberula, lobis 3 mm. longis interne totius cum coroila ad faucem dense lano-tomentosis, pilis longis intertextis, tubo glabro. *Antherae* 1·25 mm. longae, ellipticae, glabrae, filamentis crassis 1·5 mm. longis. *Ovarium* cum stylo 4·5 mm. longum, pilis erectis instructum. *S. Beddomei*, var. *coriacea*, C. B. Clarke in Hook. f. Flor. Brit. Ind. iv. p. 89; Trimen, Fl. Ceylon, pt. iii. p. 173. *S. potatorum*, Thwaites, Enum. p. 201 partim.

Ceylon. Central Province, *Thwaites* 3367.

In its pubescent stems and petioles, leathery, shortly petioled, subtriplinerved leaves, puberulous corolla with lobes densely hairy from base to apex, this plant appears to be worthy of specific rank. I have therefore followed Thwaites and also prepared a more ample description. According to Trimen its habitat is the Central Province of the island, which suggests that it is

a truly endemic species. It is unfortunate that it is represented at Kew and the British Museum by only single specimens and that no fruits have been collected.

24. **S. polytricantha,** *Gilg* in Notizbl. der Kgl. Bot. Gart. Berlin, 1897, no. 8. p. 267; A. W. Hill in Kew Bull. 1911, p. 298, with text figs.

Malay Archipelago. Borneo; Sarawak, *Beccari* 2275, 1190.

The corolla, which is 1 cm. long, is densely hairy within, both tube and lobes being covered with long woolly hairs. The corolla lobes slightly exceed the tube in length. The anthers are glabrous, 1·5 mm. long, and are borne on long filaments 2·5 mm. in length. The ovary and style are densely hairy. The fruit is large and woody but the only specimen is immature.

25. **S. dubia,** *A. W. Hill* in Kew Bull. 1911. p. 298, et figs.

Philippine Islands. Mindanao: Davao dist.; Todaya, *Elmer* 10958.

The leaves are trinerved, and the nerves on the lower surface bear scattered strigose appressed hairs—this character was overlooked in the original description. The anthers are glabrous, more or less orbicular, and are borne on relatively long filaments. In these particulars especially it differs from *S. multiflora.*

26. **S. oleifolia,** *A. W. Hill;* species *S. dubiae,* A. W. Hill, similis, foliis elliptico-lanceolatis nervis marginibus subparallelis, corolla antherisque majoribus, ovario conico cum stylo hirsuto differt.

Frutex scandens, 15-20 m. altus, ramis striatis glabris. *Folia* elongato-elliptico-lanceolata, glabra, 8-13 cm. longa, 3·5-4·2 cm. lata, acuminata, 3-5-nervia, basi rotundato-cuneata, 5-nervia, tri- vel subtriplinervia, jugo infimo tenue sub margine percurrente sensim evanescente, jugo superiore margini subparallelo et ab eo circa 6-8 mm. percurrente. *Inflorescentiae* axillares, densi- et multiflorae, 10 cm. longae vel ultra, paniculatae; pedicellis minutissime pubescentibus. *Calycis* segmenta orbiculari-ovata, subacuta, glabra, 1·5 mm. longa, marginibus ciliatis. *Corolla* circiter 8 mm. longa, tubo extra sparse hirsuto, lobis 4-4·5 mm. longis intus parte inferiore et tubo dense laneohirsutis. *Antherae* glabrae, 1·25 mm. longae, filamentis 2·5 mm. longis. *Ovarium* conicum, cum stylo 6 mm. longum, hirsutum.

Philippine Islands. Palawan: Taytay; forest slopes, common, 10-100 m., *E. D. Merrill, Bur. Sc. No.* 9364.

27. **S. micrantha,** *Thwaites,* Enum. Plant. Zeyl. p. 425 partim, *C.P.* 1866 excl.; C. B. Clarke in Hook. f. Fl. Brit. Ind. iv. p. 86 partim sed ovarium hirsutum nec glabrum; Trimen. Fl. Ceylon, pt. iii. p. 172, partim, *C.P.* 1866 excl.; Dop in Bull. Soc. Bot. Fr. lvii. Mém. 19 (1910), p. 14, var. excl. *S. colubrina* et *S. Beddomei,* Brandis, Indian Trees, p. 474

partim quoad spec. Zeylan. tantum. *S. laurina*, Thwaites, Enum. p. 201. *S. Beddomei*, Trimen, Fl. Ceylon, pt. iii. p. 173, var. excl.

Ceylon. Trincomalee & Central Province, up to 600 m., *Thwaites' C.P.* 3720 (3720 A in herb. Kew); *Thwaites* 3540.

The corolla is about 4 mm. long the lobes and tube being equal in length. The lobes in the lower part and the throat bear scattered woolly hairs. The ovary is hairy as described by Thwaites.

S. micrantha is very closely allied to *S. colubrina* from the western side of the Indian Peninsula, and its flowers especially resemble those of the specimens from Travancore. The usually narrowly-elliptic, lanceolate, acuminate leaves, and the corolla with lobes equal in length to the tube serve as a means of recognising the Ceylon specimens. *S. micrantha* may be regarded as the Ceylon representative of *S. colubrina* and both no doubt must be reckoned among the plants long known as '*lignum colubrinum*.'

It is very unfortunate that *S. micrantha* is not represented by fruits in our herbaria. The fruiting specimens assigned to it have been found to belong to *S. lenticellata*, A. W. Hill. On the sheets of *Thwaites* 3720 and 3540 at Kew, portions of fruiting specimens have been attached which are identical with *Thwaites* 1866 excluded by me from *S. micrantha*. These and no. 1866 agree so closely with *S. lenticellata*, from S.E. India that they have been referred to that species. Specimens in the Wallichian herbarium under the label "Ceylon 96 & Palamcottah 95" collected by *Rottler* in 1795 & 1796 have also been referred to *S. lenticellata*.

28. **S. colubrina,** *Linn.* Sp. Pl. p. 271; descr. emend.

Folia ovato-elliptica, elliptica vel elliptico-lanceolata, 8-12 cm. longa, 4-5·5 cm. lata, acuta vel acuminata, basi rotundato-cuneata vel cuneata, trinervia vel subtriplinervia, superne verrucosa, glabra, cirrhis bijugis, petiolis circiter 1 cm. longis. *Inflorescentiae* axillares, circiter 2·5 cm. longae, pedunculis pedicellisque pubescentibus. *Calycis* segmenta orbiculari-ovata, pubescentia, marginibus ciliatis, 1 mm. longa. *Corolla* externe glabra vel subglabra, 3·5-4 mm. longa, lobis 2-2·5 mm. longis repandis parte inferiore et ad faucem pilis laneis instructis. *Antherae* ovoideae, 0·75 mm. longae, glabrae; filamentis 0·75-1 mm. longis. *Ovarium* cum stylo 2·5-3 mm. longum, ad apicem et cum stylo pilis erectis instructum. *Fructus* globosus, glaber, circiter 1·5 cm. diametro; pericarpium crustaceum. *Semina* 1-3 (fide *Rheede*), 1·25 cm. diametro, discoidea; Linn. Amoen. (1751) ii. p. 119; Linn. Mat. Med. p. 27 partim; Linn. Suppl. p. 149; Burm. Fl. Ind. p. 58 partim; Willd. Sp. Pl. i. p. 1502, syn. Burm. Fl. Ind. p. 58 partim et Rumph. Amb. ii. cap. xlvi. excl.; Benth. in Journ. Linn. Soc. i. p. 101 spec. Wall. 1589 A. & B., 4455 B partim et syn. excl.; Dalz. et Gibs. Bombay Fl. p. 155 dubie, syn. et cit. excl.; C.B. Clarke in Hook. f. Fl. Brit. Ind. iv. p. 87, et Cooke Fl. Bombay, p. 184, syn. *S. bicirrhosa*, Lesch. et var.

zeylanica excl.; Brandis, Indian Trees, p. 474 partim; Watt Dict. Econ. Prod. Ind. vi. pt. iii. p. 378 syn. *S. bicirrhosa*, Lesch. excl.; non Dop in Bull. Soc. Bot. Fr. lvii. Mém. 19, (1910), p. 14;* *S. minor*, Blume in Rumphia, i. p. 70 partim; A. DC. in DC. Prod. ix. p. 14 quoad syn. Rheede Hort. Malab. vii. t. 5; Miq. Flor. Ned. Ind. p. 379. *Scheru-Katu-valli-Caniram*, Rheede, Hort. Malab. vii. p. 9. t. 5.

S. Beddomei, C. B. Clarke in Hook. f. Flor. Brit. Ind. iv. p. 88 spec. zeylan. et var. *coriacea* excl.; non Trimen Fl. Ceylon Pt. iii. p. 173.

Specimina excludenda:—

S. colubrina, Bl. in Rumph. l. p. 70, *S. colubrina*, Roxb. Fl. Ind. ii. p. 264 et Roxb. Fl. Ind. i. p. 577 (= *S. cinnamomifolia* var. *Wightii*, A. W. Hill, v. p. 194) etiam G. Don Dict. iv. p. 65 (cf. obs. sub. *S. cinnamomifolia*).†

S. colubrina, Burm. Fl. Ind. p. 58 quoad Rumph. Amb. ii. cap. xlvi. p. 121-122 (= *S. ligustrina*, Bl.) et quoad syn. *Modira caniram*, Rheed. Hort. Malab. viii. p. 47 t. 24 (= *S. Rheedii*, C. B. Clarke, v. p. 208), nec A. DC. in DC. Prod. ix. p. 14, nec Thwaites, Enum. Pl. Zeylan. p. 201 (= *S. micrantha*, Thw.), nec *S. Beddomei*, Trimen, Pl. Ceylon, pt. iii. p. 173 (= *S. micrantha*, Thw.).

S. India. Between Cochin and Poaha and Baypyn island, *Rheede, Hort. Malab.* vii. t. 5; Malabar, *Herb. Wight, K.D.* 1816; *Wallich* 1589‡ *Herb. Wight in Herb. Wall.; Wallich* 1589 C. in Herb. Kew.; Cochin, *Rev. E. Johnson;* Bombay, *Dalzell Herb.;* Concan, *Law* (Herb. Hook.); Bombay *Law* (Herb. Benth.); Malabar, *Beddome* 42; Travancore, foot of Ghats, *Beddome* 50; Canara, *Law;* Mangalore, *Meebold* 9587; N. Canara Dist., Santgal, *Talbot* 3703; Poona, *King's Collector; Wallich* 4455 Herb. Madras "inter plantas ab Koenigio lecta" as to fruiting specimen only§; Quilon, *Herb. Wight* 2289; without locality *Herb. Wight*, 567, 641.

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* The specimen from Coimbatore, quoted by Dop, under *S. colubrina*, proves to be *S. lenticellata*, A. W. Hill.

† It is not easy to be certain whether *S. colubrina* of Blume, Roxburgh and Don, should be referred to *S. Rheedii*, Clarke, *S. aenea*, A. W. Hill, or to *S. cinnamomifolia* var. *Wightii*, A. W. Hill. From Roxburgh's description, however, it seems clear that the corolla has a cylindric tube and the seed coat is said to be velvety; Blume adds that the leaves are triplinerved. On these points, therefore, *S. colubrina* of Blume and Roxburgh (partly also of G. Don) is referred to *S. cinnamomifolia* var. *Wightii*; and *Modira caniram* of Rheede, which, according to the picture, has a very short corolla tube, is left as the type of *S. Rheedii*, C. B. Clarke.

‡ The other Wallichian plants under the No. 1589 are No. 1589b which is *Celtis Wightii* (see Benth. in Journ. Linn. Soc. i. p. 101); No. 1589 (i) herb. Lesch. = *S. bicirrhosa*, Lesch.; No. 1589 (2) herb. Heyn = *S. lenticellata*, A. W. Hill. No. 4455 herb. Heyn in herb. Wallich proves to be *S. Nux-vomica* (see Benth. l.c.).

§ Wallich's No. 4455 Herb. Madras "inter plantas ab Koenigio lecta" has been referred to *S. Beddomei* by C. B. Clarke (see Flor. Brit. Ind. iv. p. 88). There are two specimens on the sheet, the upper bearing flowers proves to be *S. laurina*, Wall., the anthers being bearded at the base, &c., and was no doubt collected by Koenig when he went to Malacca and Siam in 1778–79 (see Lasègue, Mus. Bot. Delessert, p. 557). The lower fruiting specimen represents *S. colubrina*.

Linnaeus founded his species *S. colubrina* on Rheede's picture in the Hortus Malabaricus, vol. vii. p. 9. t. 5, and there is no corresponding specimen in the Linnean Herbarium. The Wallichian specimen 1589 *herb. Wight* is, however, without doubt the same thing as the plant figured by Rheede. The first confusion was introduced by Willdenow, who adds references to Burm. Fl. Ind. in which Hort. Malab. viii. p. 47, t. 24, is cited (this is the type of *Strychnos Rheedii*, C. B. Clarke), and also to Rumph. Amb. ii. p. 121, which is the Timor plant (*S. ligustrina*, Bl.). At the end, however, he adds that *S. colubrina* **is a native of India!**

Roxburgh augments the confusion by quoting from Willdenow not only the wrong figure in Rheede, but also by giving a description of his conception of Linnaeus' *S. colubrina*, and including Smith's plant from Silhet as a specimen. This particular specimen is *S. axillaris*, Colebr., and belongs to a different section of the genus. De Candolle only continued the confusion as did also Bentham, who added to it by including *S. bicirrhosa*, Lesch. as a synonym of *S. colubrina*. To C. B. Clarke in the Flor. Brit. Ind. iv. p. 87, is due the credit of establishing clearly what Linnaeus intended as his *S. colubrina*, but unfortunately in his synonymy he included *S. bicirrhosa*, Lesch., following Bentham, and also established a variety *zeylanica* from Ceylon.

This latter proves to be quite a distict species, and is described herein under the name *S. trichocalyx*, A. W. Hill (see p. 174), belonging to the *Penicillatae* section of the genus. It is the plant which Bentham places under *S. minor*, Bl. as var. *nitida* and unfortunately suggests that it may be the plant figured by Rheede in Hort. Malab. vii. t. 5.

Dop adds to this confusion by citing under *S. micrantha* a Pierre specimen from Ceylon and another from Cochin, both with glabrous ovaries. On inspection of the specimens at Paris it was found that the Indian plant represents *S. Dalzellii*, C. B. Clarke, while the Ceylon plant is *S. trichocalyx*. Dop placed them under *S. micrantha*, following Clarke in his mistaken statement that the ovary in that species is glabrous, whereas Thwaites states that it is villous (Enum. p. 425), which is confirmed by our own observation.

With regard to *S. Beddomei*, Clarke, no essential differences have been found to separate it from *S. colubrina*, Linn. and it has therefore been reduced. Clarke compares it to *S. laurina* from Malaya, and on Wallich's sheet 4455 (*Koenig*) the two species are mixed. *S. laurina*, however, differs in the leaves and in having bearded anthers, and a much larger panicle of flowers.

In the Hortus Malabaricus Rheede's picture of the small fruit shows three seeds in section, and in his description he says "*Semina* minime." *S. colubrina* is one of the four plants referred to by Rheede under the name 'Caniram' and is one of two known as 'Valli-Caniram' (see Rheede l.c. i. p. 67).

29. **S. lenticellata,** *A. W. Hill;* species ex affinitate *S. colubrinae*, Linn., et *S. micranthae*, Thw., sed ramis lenticellis con-

spicue instructis, foliis triplinerviis minoribus, segmentis calycis angustioribus, antheris orbicularibus distincta.

Frutex scandens, ramis et ramulis striatis lenticellis insigniter instructis, cirrhis bijugis glabris. *Folia* obovata vel elliptico-obovata, basi et versus apicem cuneata, acuta vel subacuta, mucronulata, aliquando retusa, 5-7 cm. longa, 2 cm. lata, glabra, superne vernicosa, triplinervia, venis nervisque prominentibus; petioli 5 mm. longi, e basi tumido orti. *Inflorescentiae* axillares, multiflorae, circiter 3 cm. longae; pedunculis et pedicellis pubescentibus. *Calyx* 1·25-1·5 mm. longus, segmentis anguste ovatis vel ellipticis subacutis subglabris vel pubescentibus marginibus hirsutis. *Corolla* 3·5-4 mm. longa, lobis repandis 2-2·5 mm.

longis ovato-lanceolatis subacutis parti inferiore pilis laneis sparsis instructis tubo glabro. *Antherae* orbiculares, 0.65 mm. diametro, filamentis 1-1·25 mm. longis. *Ovarium* cum stylo 3 mm. longum, hirsutum, ovario apice praecipue pilis erectis instructo. *Fructus* globosus, circiter 2 cm. diametro, 1-2-spermus; pericarpium crustaceum. *Semen* orbiculare, 1·4 cm. diametro, planum, circiter 2 mm. crassum, glabrum. *S. potatorum*, Thwaites, Enum. p. 201 quoad *C.P.* 1866. *S. micrantha*, Thwaites, Enum. p. 425 et Trimen. Flor. Ceylon, pt. iii. p. 172 quoad *C.P.* 1866.

Vern. Name. Cheroomolaghoo, according to a label on a specimen, dated 1828, in herb. Wight preserved in the University Herbarium, Glasgow.

S. India. Madras: Cuddapah Hill (7/81), *Beddome* 6, 5305 in herb. Mus. Brit.; Madras, without precise locality, *Wight & Heyn* (*Wallich* 1589 b. in herb. Heyn); Negapatam, *Herb. Wight;* Kurnool Hills *Beddome* (1878); Palamcottah (1795), *Rottler* 30 *Wallich* 1585 b. (herb. Klein?) in herb. Wall.; Chingleput Dist.; Kambakkam Droog, *Bourne* 2533; Kambakkam Hills (May 1913, fruit), *Barber* 8862 in Coimbatore Coll. herb.; Kouri Kandjera, *Leschenault* in herb. Mus. Paris.

Ceylon. *Rottler* 1796; *Wallich* 1585 b. in herb. Wall.; without precise locality, *Thwaites* 1866; also fruiting specimens attached to sheets of *Thwaites* 3720, 3540 in herb. Kew; fruits (labelled "near *axillaris*") Colombo, *Ferguson* in Mus. Kew.

A very distinct species with its stems closely covered by conspicuous lenticels. The triplinerved leaves are relatively small and uniform in size, tapering regularly towards base and apex. In the flowers the orbicular anthers afford a useful character for distinguishing the species and the calyx segments are much narrower than is common in allied species.

Wight on his label when sending the plant to Sir W. Hooker under the name *S. colubrina* (?) suggests that it is a new species, since Willdenow in contradiction to Indian botanists said it was not *S. Nux-vomica*. Specimens collected by Rottler at Palamcottah in 1795 and Ceylon 1796 and placed by Wallich under his number 1585 with *S. potatorum* also belong to this species.

Some references to the Ceylon specimens will be found in the note under *S. micrantha*, Thw. (see p. 157): There is a bottle of ripe fruits with two leaves in fluid in the Kew Museum bearing the label "*Strychnos* near *axillaris*, Colombo, W. Ferguson," which apparently belong to *S. lenticellata*. They are about 2 cm. in diameter, 2-seeded with a fleshy pericarp 5 mm. thick.

It is unfortunate that Thwaites gave no exact localities with his specimens. Trimen under *S. micrantha* (with which *S. lenticellata* is included), gives 'Low Country' as the habitat, and mentions Peradeniya, Galle and Trincomalee as localities. Whether these all refer to *Thwaites* 1866 as well as to the true *S. micrantha* is uncertain.

Judging from the localities in which the Indian specimens have been collected, *S. lenticellata* is a dry country plant, and it would be likely to occur in similar situations in Ceylon, and therefore in the northern drier portion of the island which is in all essentials a part of India.

30. **S. Merrillii,** *A. W. Hill* in Kew Bull. 1911. p. 297; descr. emend; species *S. multiflorae*, Benth., affinis, foliis floribusque minoribus ramis parce pubescentibus praecipue differt.

Frutex scandens, ramis parce et minutissime pubescentibus. *Folia* elliptico-ovata, plus minusve abrupte et longe acuta vel acuminata, basi rotundato-cuneata, 6-8·5 cm. longa, 3-3·5 cm. lata, 5-nervia, triplinervia, superne glabra, venis reticulationibus conspicuis inferne nervis praecipue parce pubescentibus pilis adpressis vel glabris, petiolis circiter 1 cm. longis parcissime pubescentibus. *Inflorescentiae* axillares et terminales, 7-9 cm. longae, laxe paniculatae, tenues; pedunculis pedicellisque minutissime et dense pubescentibus. *Calycis* segmenta orbicularia, 1 mm. longa, obtusa, marginibus minutissime ciliatis. *Corolla* 5-5·5 mm. longa, lobis tubo aequilongis elliptico-lanceolatis acutis externe minute pubescentibus interne parte superiore glabris inferiore et cum tubo dense laneo-hirsutis. *Antherae* glabrae, 0·75-0·9 mm. longae, ellipticae, apiculatae, filamentis 1 mm. longis. *Ovarium* globulare, 1 mm. diametro,

parce puberulum; stylus 4 mm. longus, parce hirsutus. *Fructus* immaturus (?) circiter 1·8-2 cm. longus.

Philippine Islands. Luzon: Prov. Rizal; Bosoboso, *E. D. Merrill* 2807; Prov. Laguna; San Antonio, 205 m., *Ramos, Bur. Sc. No.* 23814.

This species has been placed under *S. luzonensis* in the Herbarium of the Bureau of Science, but it is quite a distinct species.

The description has been entirely redrawn as the new material (*Ramos* 23814), shows that the flowers in the previously described specimens were only in the bud stage and the corolla tube had not developed.

This species is certainly nearly allied to *S. multiflora*, but is smaller in all its parts and may be distinguished by the pubescence of the stems, the smaller, narrow leaves and the hairy style. With its lax, slender inflorescences like those of a *Ligustrum* it is seen to be quite distinct from *S. multiflora*.

There are several other narrow-leaved specimens from central Luzon without flowers which probably should be referred to *S. Merrillii*, namely *Williams* 350 from Mt. Mariveles, Prov. Bataan and *Elmer* 7820, 7885 from Prov. Tayabas, with sparsely pubescent stems. The Elmer specimens have ovoid fruits 2-2·5 cm. long. There is also a specimen collected by *Ramos* (no. 16621) at San Antonio, Laguna Province, which resembles *S. Merrillii*, but the stems seem scarcely pubescent. The fruits of this specimen contain 3 flattened oblong seeds 2 cm. long by 1·5 cm. broad.

31. **S. pycnoneura,** *Gilg et Benedict* in Engl. Bot. Jahrb. liv. p. 164 et figs.

New Guinea. Kaiser-Wilhelmsland: Woods at foot of Bismarck Mts.; 150 m., *Schlechter* 18478 (Fl. Oct.).

It is possible that this species may belong to the section *Penicillatae*, but this cannot be determined from the figures given by Gilg and Benedict. In both *S. Forbesii*, A. W. Hill, and *S. laurina*, Wall., to which the authors suggest it may be allied, the anthers are bearded.

32. **S. myriantha**, *Gilg et Benedict* in Engl. Bot. Jahrb. liv. p. 167 et figs.

New Guinea. Kaiser-Wilhelmsland: Hauptlager Malu am Sepik; alluvial forests, 40-50 m., *Ledermann* 10706; 10611 (Fl. Jan.); in forests near Kaulo-Etappe, 400 m., *Schlechter* 17184 (Fl. Jan.).

The plant as figured with its large paniculate inflorescences 12-14 cm. long, and large triplinerved leaves resembles *S. multiflora*. The anthers are glabrous and are borne on relatively long filaments and the ovary is densely hairy.

33. **S. multiflora,** *Benth.* in Journ. Linn. Soc. Bot. i. p. 102; Hook. Ic. xxiii. t. 2213; Vidal, Pl. Vasc. Filip. p. 191;

Miq. Flor. Ned. Ind. ii. add. p. 1080; A. W. Hill in Kew Bull. 1911. p. 300 partim (?) cum Ic. et figs.—*S. luzonensis*, Elmer in Leafl. Philipp. Bot. i. (1908), p. 332 quoad *Elmer* 7885.—*S. potatorum*, L. var. *multiflora*, Vid. Sineps. t. 69, fig. D; "Camotain," Blanco, Flor. Filip. August. t. 208. ed corr.

Philippine Islands. Luzon: Prov. Benguet; Baguio, *Elmer* 8960. Prov. Rizal; *Ahern's Collector* 2875, 3249; Dist. Morong, *Vidal* 1615, 3316; *Loher* 4113, 4114, 4115, 4116, 6483, 6506, 6523, 6540; *Gaudichaud* 305; *Calléry* 40. Prov. Bataan; Mt. Marivales, *Elmer* 6864. Prov. Batangas, *Cuming* 641, 695, 1482. Priv. Albay, *Cuming* 1059.

The leaves are tripli- or quintuplinerved. The corolla measures from 6-7 mm. in length, the lobes being glabrous, and a ring of woolly hairs occurs at the throat. The anthers are about 1·65 mm. in length and glabrous. The style is glabrous or subglabrous, and the ovary is crowned with a mass of erect hairs.

From a careful re-examination of the material at Kew and from specimens kindly sent from the Bureau of Science Herbarium, Philippine Islands, it seems probable that *S. multiflora*, Benth., is confined to the islands of Luzon and Mindoro. The Culion Island plant (cited in *K.B.* 1911), is undoubtedly distinct, but unfortunately the specimen consists only of two leaves and some fruits.

The specimens from Mindanao (see *K.B.* 1911, l.c.), are either leaf specimens with fruits or else have the flowers only in bud. In the former (*Williams* 2131) the fruit is ovoid and smooth. In the latter (*Clemens* 539; *Lyon*), owing to the condition of the flowers, it is not possible to assign the specimens positively to *S. multiflora* or to any other species though they might well belong to *S. lanata*, A. W. Hill. (See footnote p. 126.)

The Ceram specimen (*K.B.* 1911, l.c.), also consisting of leaves and fruit only, cannot safely be placed under *S. multiflora*; it closely resembles a specimen also consisting of leaves and fruit only collected in Amboina by the late *C. B. Robinson*, no. 2030.

As was mentioned in *K.B.* 1911, p. 301, there are some narrow-leaved specimens from Luzon without flowers which probably represent a narrow-leaved form of *S. multiflora*, the fruits when present are rugulose as in the type. These specimens have in some cases been identified as *S. luzonensis*, but the leaves are quite glabrous.

The following specimens at Kew and at Manila bear narrow, lanceolate, acuminate leaves markedly cuneate at the base.

Luzon. Prov. Bataan, *Williams* 350; Prov. Tayabas, *Elmer* 7820; 7885; *Whitford* 776; Prov. Laguna, *Ramos*, *Bur. Sc. No.* 16621.

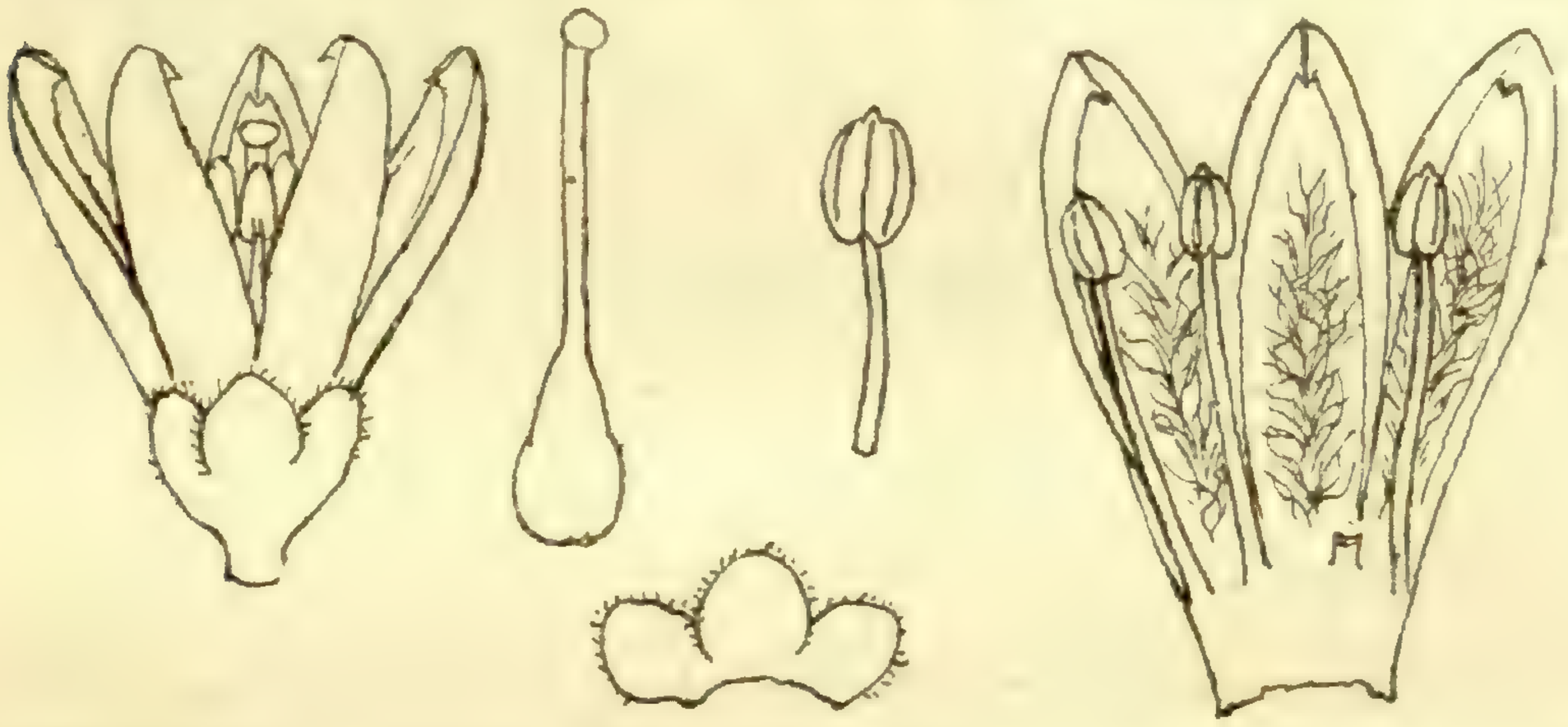
There are two other imperfect specimens from Luzon of doubtful affinity, *Ramos* 1388 from the Prov. Laguna with pubescent stems almost tri-nerved highly reticulate and very acuminate leaves and small round smooth fruits, and *Alvarez*, *For. Bur. No.* 23750 from the Camarines Prov., Luzon, with triplinerved leaves and yellow oily fruits. The latter is said to be a tree and

shows some resemblance to *S. multiflora*, but both it and *Ramos* 1388 no doubt represent undescribed species.

Another doubtful plant allied to *S. multiflora* is *Ramos Bur. Sc. No.* 21735, from the Province of Bulacan; it shows considerable resemblance to *S. multiflora*, but both in the flowers and leaves there are several small differences. It would seem unwise either to describe it as a new species or to assign it to *S. multiflora* on the single specimen.

34. **S. Curtisii,** *King & Gamble*, Mat. Flor. Mal. Penins. iv. p. 824 partim; descr. emend.

Frutex scandens, 30-45 m. altus vel ultra; caudex 10-30 cm. diametro, ramis crassis striatis in juventute pubescentibus lenticellis elongatis instructis. *Folia* oblongo-ovata, elongata, apice sensim acuta vel acuminata, basi rotundata vel rotundato-cuneata, circiter 9-13 cm. longa, 3·5-5·5 cm. lata, superne vernicosa, glabra, inferne pilis sparse instructa, 5-nervia, subtripli- vel trinervia; venis inconspicuis petiolis 1 cm. longis minute pubescentibus. *Inflorescentiae* axillares, paniculatae, multi-



florae, 3·5-4·5 longae, pedunculis pedicellisque pubescentibus. *Calycis* segmenta 1 mm. longa, rotundato-ovata, subacuta, glabra, crassa, concava, marginibus ciliatis. *Corolla* circiter 7·5 mm. longa, externe glabra, lobis anguste elliptico-lanceolatis carnosis cucullatis 5 mm. longis acutis pilis laneis dense instructis; tubo breve glabro. *Antherae* 1 mm. longae, glabrae, exsertae; filamentis 2-2·25 mm. longis. *Ovarium* cum stylo 5·5 mm. longum, pilis erectis instructum. *Fructus* globosus, 2·5-4 cm. diametro; pericarpium laeve, 0·5 mm. crassum. *Semina* 2-4 rotundato-ovoidea, plana, compressa, glabra, circiter 1·6 cm. longa. *S. Maingayi*, King & Gamble, Mat. Flor. Mal. Penins. iv. p. 824, quoad *King's Collector* 8190.

Malay Peninsula. Perak: Gunong Bubu; dense jungle clinging to large trees, 450-610 m. (Fl. June), *King's Collector* 7702; Goping Dist., 90-150 m. (Fr. Sept.), *King's Collector* 8190. Penang: Government Hill; 210-240 m. (Fl. Apr.), *Curtis* 2973.

The specimens collected by *King's Collector* 10281, 10438 included by King & Gamble under *S. Curtisii* prove to belong to *S. septemnervis*, C. B. Clarke.

S. Curtisii is a very distinct plant with its long densely-hairy corolla lobes, short tube and anthers borne on long filaments. It is easily distinguished from *S. septemnervis* by its elliptic straight-sided subtripli- or trinerved leaves with inconspicuous veins. The leaves resemble those of *S. Maingayi*, but are much less varnished than in that species.

The fruiting specimen (*King's Collector* 8190), was placed by King & Gamble under *S. Maingayi*, but from the character of the lenticels and the hairy stems, etc., there can be little doubt that it belongs to *S. Curtisii*. According to the collector's label it is a "very large creeper over 150 ft. long, stems 8-12 in. in diameter."

35. **S. lanata,** *A. W. Hill* in Kew Bull. 1911. p. 299, with text figs.

Philippine Islands. Mindanao; Lake Lanao, *Clemens* 747.

The leaves are triplinerved. The corolla is 7-8 mm. long, the lower part of the lobes and the tube being densely covered with woolly hairs, and the lobes are 5-5·5 mm. long. The anthers are apiculate and glabrous and the ovary and style are hairy.

It is possible that the specimens from Mindanao, referred to *S. multiflora* in *Kew Bull.* 1911. p. 300, really belong to *S. lanata*. The determination was based mainly on the leaf characters as the flowers were not fully developed (see pp. 126 and 163).

Section iii. **Penicillatae.**

36. **S. Benthami,** *C. B. Clarke* in Hook. f. Flor. Brit. Ind. iv. p. 87; descr. emend. et ampl.

Caules quadrangulares, pubescentes. *Folia* ovato-lanceolata. acuta vel acuminata, versus basin plus minusve cuneata vel rotundato-cuneata, 5·5-7·5 cm. longa, 2·5-3·5 cm. lata, superne glabra, pagina inferiore nervo medio hirsuto, 5-nervia, plus minusve triplinervia, nervis intermediis curvatis; petioli 2-3 mm. longi, pubescentes. *Inflorescentiae* axillares, pauciflorae. 5-8 mm. longae; pedunculis pedicellisque pubescentibus. *Calycis* segmenta 4, triangulari-orbiculata, breviter acuta, marginibus breviter ciliatis, intus glabra. *Corolla* 2·5-2·75 mm. longa. lobis 4 crassis 1·5-1·75 mm. longis medio linea pilorum notatis. *Antherae* 0·75 mm. longae, apiculatae, in sinubus insertae, basi barbatae. *Ovarium* cum stylo glabrum, 1·5 mm. longum. *Bacca* circiter 1 cm. diametro; pericarpium crustaceum; Dop in Bull. Soc. Bot. Fr. lvii. Mém. 19 (1910), p. 15; Trimen Fl. Ceylon, pt. iii. p. 174; *S. minor*, Benth. (non Blume) et var. *ovata*, Benth. in Journ. Linn. Soc. i. p. 100; *S. minor*, Thwaites (non Blume) in Enum. Plant. Zeylan. p. 201.

Ceylon. Colombo (1860), *Thwaites* 187; without precise locality, *Mrs. General Walker; Col. Walker* 244; *J. S. Mackenzie; Dr. Kelaart.*

The specimens under the name *S. colubrina*, Ind. Orient. Herb. D. van Royen et herb. Koenig in herb. Mus. Brit. apparently belong to *S. Benthami*.

var. **parvifolia,** *Benth.* in Journ. Linn. Soc. i. p. 101.

Folia ovata, coriacea, marginibus reflexis, 2-2·5 cm. longa, 1-1·8 cm. lata. *Inflorescentiae* pauciflorae, pleraeque terminales. *S. Benthami*, C. B. Clarke var. *parvifolia*, Benth., C. B. Clarke in Hook. f. Flor. Brit. Ind. iv. p. 87; Trimen Fl. Ceylon, pt. iii. p. 174; Dop l.c. p. 15.

Ceylon. Adams Peak (1846), *Thwaites* 341; *Gardner* 580.

var. **angustior,** *Benth.* in Journ. Linn. Soc. i. p. 101.

Folia anguste ovato-lanceolata, acuminata, 3·5-6 cm. longa, 1·1-2 cm. lata, basi anguste cuneata. *Inflorescentiae* pleraeque axillares; Trimen, Fl. Ceylon, pt. iii. p. 174. *S. minor*, Benth. var. *parvifolia*, Thwaites, Enum. p. 201.

Ceylon. Matelli East (1863), *Thwaites* 341; Balanoda (1846), *Thwaites* 187.

S. Benthami, with two of its varieties, *parvifolia* and *angustior* as distinguished by Bentham, is distinct from other species in having a 4-merous corolla and calyx. The young twigs, leaf petioles and the back of the midrib are pubescent. The variety *ovata* of Bentham is not maintained as there is no good character to distinguish it from the type. Bentham's variety *nitida* with its 5-merous flowers, calyx hairy within, rhomboid leaves, etc., has been described as a new species under the name *S. trichocalyx*, A. W. Hill (see p. 174).

37. **S. quintuplinervis,** *A. W. Hill;* species *S. pubescenti*, C. B. Clarke, affinis, foliis late ovatis majoribus glabris calycis segmentibus acutis floribus majoribus praecipue differt.

Frutex scandens; caulibus petiolis et pedunculis pubescentibus. *Folia* late ovata vel ovato-lanceolata, acuta vel acuminata, basi roundata vel rotundato-cuneata, circiter 8-10 cm. longa, 4·5-6 cm. lata, glabra (in sicco fusca), quintuplinervia, superne vernicosa, venis transversis distantibus. *Inflorescentiae* axillares; corymbi 1·5-2 cm. longi, multiflori. *Calycis* segmenta triangulari-ovata, acuta, 1 mm. longa, marginibus ciliatis. *Corolla* 4 mm. longa, lobis 1·5 mm. longis ovatis acutis ad basin linea pilorum transverse notatis. *Antherae* in tubo insertae, 0·65-0·75 mm. longae, ad basin tantum barbatae. *Ovarium* cum stylo glabrum, 2 mm. longum. *Bacca* (*Curtis* 3044) ovoidea, 2·5-3 cm. longa, monosperma; pericarpium crustaceum. *Semina* 2 cm. longa, plana. *S. malaccensis*, King & Gamble, Mat. Flor. Mal. Penins. iv. p. 829, partim non Benth. *S. ovalifolia*. Gamble. l.c. p. 826 partim non Wall.

Malay Peninsula. Penang: 30-150 m. (April), *King's Collector* 1539; Waterfall near Stone Quarry (Fr. July), 60 m., *Curtis' Collector* 3044; Govt. Hill, *Curtis* 3044 (?); waterfall, *Ridley* 5538 in herb. Mus. Brit.; Muka Head, *Curtis* 1515; rocky locality, dense jungle, 90-150 m., *King's Collector* 4865.

38. **S. pubescens,** *C. B. Clarke* in Hook. f. Flor. Brit. Ind. iv. p. 89; descr. ampl.

Frutex scandens (*Curtis*) omnino dense pubescens. *Folia* ovata, acuta vel acuminata, basi rotundata vel rotundato-cuneata vel subcordata, 4·5-6 cm. longa, 2-3 cm. lata, pubescentia, 5-nervia, quintuplinervia, pilis paginae inferioris areolis coloratis circumdatis, nervis praecipue pubescentibus, petiolis brevibus dense pubescentibus. *Inflorescentiae* axillares vel terminales, corymbiformes, compactae, 1-1·5 cm. longae. *Calycis* segmenta orbiculari-ovata, subacuta, pubescentia, marginibus ciliatis. *Corolla* 3·65 mm. longa, lobis 1·4 mm. longis crassis cucullatis ad basin linea pilorum notatis. *Antherae* in tubo medio insertae, apiculatae, 0·65 mm. longae, basi barbatae. *Ovarium* cum stylo circiter 1·5 mm. longum, glabrum. *Fructus* pericarpio crustaceo instructus. *Semina* peltata, hemispherica, circiter 7 mm. diametro; King & Gamble, Mat. Flor. Mal. Penins. iv. p. 830 partim; Dop in Bull. Soc. Bot. Fr. lvii. Mém. 19 (1910), p. 16 et in Lecomte, Flor. Gén. Ind.-Chin. iv. p. 165 spec. Ind.-Chin. excl.; A. W. Hill in Kew Bull. 1911, p. 292.

Malay Peninsula. Malacca: *Maingay* 1974 (*K.D.* 1040); Bukit Bruang (May), *Curtis* 3494.

Singapore: Bukit Tunah, 150 m., *Ridley* 6317.

Borneo. Sarawak; Mattang, *Beccari* 2035.

Thorel's plant from Angkor placed by Dop under *S. pubescens* proves to be a new species which has been described and given the name *S. mucronata*, A. W. Hill (see p. 187).

39. **S. Ridleyi**, *King & Gamble*, Mat. Flor. Mal. Penins. iv. p. 831; descr. ampl.

Frutex glaber. *Folia* glabra, nervorum axillis paginae inferioris excepta, subtriplinervia. *Inflorescentiae* axillares, circiter 1·5 cm. longae, pauciflorae. *Calycis* segmenta glabra, marginibus ciliatis. *Corolla* 4-4·25 mm. longa, lobis circiter 1·5 mm. longis intus ad basin linea pilorum transverse notatis etiam parte superiore pilis erectis copiose instructis. *Antherae* 0·75 mm. longae, basi barbatae, filamentis 0·5 mm. longis in tubo insertis. *Ovarium* cum stylo glabrum; non Dop in Bull. Soc. Bot. Fr. lvii. Mém. 19 (1910), p. 16, nec in Lecomte, Flor. Gén. Ind.-Chin. iv. p. 165.

Singapore. Toas, *Ridley* 6313.

A distinct plant with its glabrous subtriplinerved or almost trinerved leaves. The corolla lobes are unlike those of other species in this section in being provided with a mass of erect hairs covering the inner faces above the transverse line of bristles.

Three distinct plants in the Paris Herbarium have been placed by Dop under *S. Ridleyi*. The specimens collected by *Pierre* belong to *S. armata*, A. W. Hill; those by *Thorel* near Ti-tinh consist of leaves only which resemble those of *S. Scortechinii*. A. W. Hill, while the third set collected at Pak-lay by *Thorel* show some general resemblance to *S. trichocalyx*, A. W. Hill, and probably represent an undescribed species.

40. **S. Robinsonii,** *A. W. Hill*; species distincta, foliis glabris grandis conspicue venatis.

Frutex scandens, lignosa, ramis in juventute pubescentibus, internodiis elongatis. *Folia* elliptico-lanceolata, acuta vel subacuminata, basi rotundato-cuneata, 10-16 cm. longa, 4·5-8 cm. lata, glabra, triplinervia, nervis pagina superiore paullo impressis venis eminentibus; petioli in juventute pubescentes, 0·5-1 cm. longi. *Inflorescentiae* axillares, paniculatae, 2·5-3 cm. longae et latae, pauciflorae; pedunculis pedicellisque hirsutis. *Calyx* 1 mm. longus, subglaber, segmentis late ovatis acutis marginibus ciliatis. *Corolla* 4·5 mm. longa, lobis 2 mm. longis intus ad basin linea pilorum notatis. *Antherae* triangulares, 1 mm. longae, in tubo medio insertae, basi barbatae. *Ovarium* cum stylo glabrum, 2·25 mm. longum. *Fructus* globosus, circiter 2 cm., diametro; pericarpium crustaceum, glabrum.

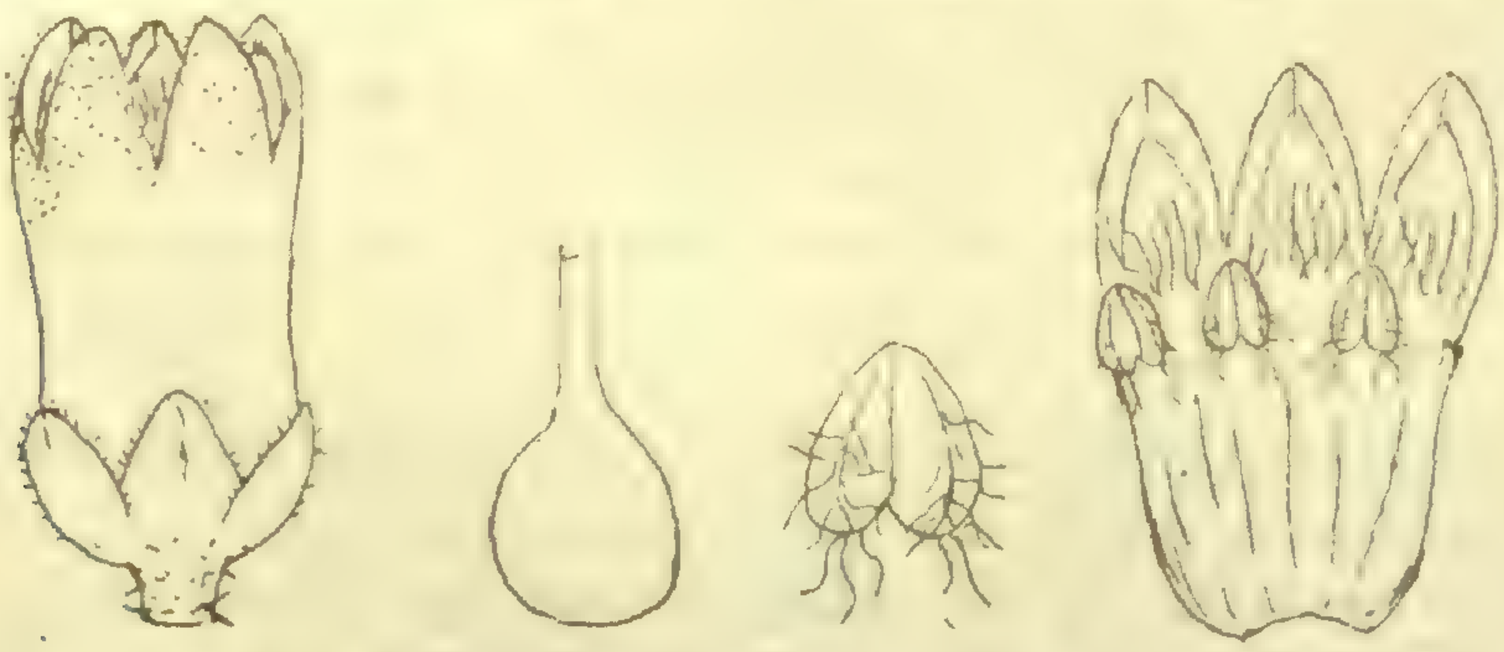
Amboina. Hitoe messen; in forests, 200 m. (Oct.), *C. B. Robinson* 2029.

A very distinct species with its large, conspicuously veined leaves. The name is given in memory of the late C. B. Robinson who was killed in Amboina when collecting over the classic ground visited by Rumphius.

Another *Strychnos* collected by Robinson in Amboina (no. 2030), is unfortunately indeterminable owing to lack of flowers, but certainly represents a distinct species.

41. **S. Scortechinii,** *A. W. Hill*; species *S. pubescenti*, C. B. Clarke, affinis, foliis ovatis vel ovato-ellipticis laevibus trinervis vel subtriplinervis dense rufo-pubescentibus antheris marginibus barbatis distincta.

Frutex scandens, 10-15 m. longus, omnino dense rufo-pubescens, ramulis horizontalibus. *Folia* ovata vel ovato-elliptica, 4-9 cm. longa, 2·5-3·5 cm. lata, basi cuneata vel rotundata, trinervia vel in foliis grandibus subtriplinervia, venis distantibus paginis laevibus inferiore praecipue dense rufo-pubescentibus, cirrhis simplicibus. *Inflorescentiae* axillares, congestae, circiter 1 cm. longae, pedunculis pedicellisque brevibus subglabris. *Calycis* segmenta rotundata vel truncata, subacuta, 0·5 mm. longa, glabra, marginibus ciliatis exceptis.



Corolla 3-3·5 mm. longa, lobis 1-1·5 mm. longis ad basin linea pilorum notatis. *Antherae* in tubo insertae, 0·65 mm. longae, basi et ad margines barbatae. *Ovarium* globulare, glabrum;

stylus 1 mm. longus. *Bacca* obovoideo-oblonga, elongata, 2-2·2 cm. longa, 1-1·2 cm. diametro, 1-2 sperma; pericarpium tenue, vernicosum, crustaceum; semina ovoideo-elliptica, acuta, plano-subconvexa, 1·7 cm. longa, 7-8 mm. lata. *S. rufa*, King & Gamble, Mat. Flor. Mal. Penins. iv. p. 827 partim, non Clarke in Hook. f. Flor. Brit. Ind. iv. p. 89. *S. pubescens* var. *Scortechinii*, King & Gamble l.c. p. 830.

Malay Peninsula. Perak: Larut: open sandy marshy ground; 90 m. (March), *King's Collector* 3973; 6199; 7839; 10187; Kelan Tujor, 150 m. (April), *L. Wray Jr.* 4033; 1344; 2894.

Selangor: *Curtis* 2398 (teste Icon. J. S. Gamble in herb. Gamble); Dambung Batak, *Scortechini* 1858; Campar, *Ridley* 9698.

The fruit is obovoid with a thin pericarp and contains one or two seeds. It is very different from the large, many-seeded fruit of Clarke's *S. rufa*, founded on Maingay's plant from Malacca (see p. 203).

The specimens turn black on drying; the leaves, except when very large, are trinerved and are unlike those of *S. pubescens*, C. B. Clarke, which are quintuplinerved and remain green when dried.

42. **S. axillaris,** *Colebr.* in Trans. Linn. Soc. xii. 356. t. 15 descr. ampl.

Frutex, ramis et ramulis pubescentibus; cirrhis singulis. *Folia* triplinervia, glabra nervis paginae superioris excepta, superne vernicosa, in siccitate atro-fusca, nervis pubescentibus, pagina inferiore nervorum angulis pubescentibus; petiolis pubescentibus. *Inflorescentiae* axillares, compressae. *Calycis* segmenta triangulari-ovata, acuta, marginibus exceptis glabra. *Corolla* 2·5 mm. longa, lobis 1 mm. longis acutis ad basin linea pilorum transverse notatis. *Antherae* ovatae, apiculatae, 0·75 mm. longae, basi barbatae, subsessiles, in tubo medio insertae. *Ovarium* cum stylo glabrum, 1·75 mm. longum. *Fructus* elliptico-globularis, olivae magnitudine, monospermus (*Colebrooke*); Wall. Cat. 1587; G. Don, Dict. iv. p. 66; A. DC. in DC. Prodr. ix. p. 13; Roxb. Fl. Ind. ii. p. 266; Benth. in Journ. Linn., Soc. i. p. 101; C. B. Clarke in Hook. f. Flor. Brit. Ind. iv. p. 89; Brandis, Indian Trees, p. 475; Dop in Bull. Soc. Bot. Fr. lvii. Mém. 19, p. 16; non Dalz. et. Gibs. Bomb. Fl. p. 155.

India. E. Bengal: Silhet; *M. R .Smith & W. Gomez in Herb. Wallich* 1587; Khasia Hills, Jasper Hill (June), *Hooker & Thomson* 1147; *Griffith K.D.* 3721; Assam, Lumathu Hills, *Prazer* 79.

S. axillaris is a particularly distinct plant in the dry condition since leaves and flowers become a black-brown, whereas *S. pubescens*, to which it shows some resemblance, always remains a yellowish-green colour. The nerves on the upper surfaces of the leaves bear a line of hairs, and on the under surface there is a pocket of hairs in the angles of the nerves. The flowers

bear a transverse line of erect bristle-like hairs across the base of the corolla lobes characteristic of all the species in this section of the genus. *S. axillaris* is correctly described by Colebrooke and also by Wallich in Roxb. Fl. Ind. ii. p. 266.

Some doubt has arisen as to this species and Roxburgh's *S. colubrina*, since both plants were found by M. R. Smith, indigenous on the hills near Silhet, and Smith's specimen assigned to *S. colubrina* by Roxburgh cannot be found in any herbarium. Hooker & Thomson and also Prazer collected a second *Strychnos* near Silhet, which is apparently Smith's lost plant.

Smith recognised that he had found two distinct plants near Silhet, as his label on *S. axillaris* bears the MS. name *S. Harkuchila*, and the remark "diff. a *St. colubrina*," the reference being no doubt to his Silhet plant described under that name in the Flora Indica by Roxburgh.

Colebrooke's figure is a very good one, and shows the fruit as a small berry about the size of an olive with a solitary seed. The plant turns black or dark-brown on drying as do certain other species in this section of the genus.

S. axillaris is quite distinct from *S. Tieuté*, Lesch. from Java, with which Colebrooke suggests a comparison.

43. **S. Schmidtii,** *Gilg* in Flora of Koh Chang (Bot. Tidssk. xxxii. April, 1916), pt. x. p. 388 (312); descr. ampl.

Folia trinervia. *Flores* immaturi corollae lobi ad faucem linea pilorum notati. *Antherae* in tubo insertae, subapiculatae, 0·65 mm. longae, basi et marginibus parte inferiore barbatae. *Ovarium* cum stylo glabrum, 1·65 mm. longum.

Siam. Rocks in jungle at Klong Prao (March), *Schmidt* 703.

This species shows some resemblance to *S. Ridleyi*, King & Gamble, from Singapore, but there is not sufficient material to assert that it is closely related.

44. **S. armata,** *A. W. Hill*; arbor parva, spinis teretibus foliisque trinervis distincta.

Arbuscula 3-8 m. alta, ramis decumbentibus facie *Canthii*, (*Pierre*), in juventute pubescentibus spinis teretibus axillaribus 5-6 mm. longis interdum instructis. *Folia* elliptico-ovata vel lanceolata, basi cuneata, apice acute acuminata, superne vernicosa, in siccitate atro-fusca, trinervia, nervo medio pagina superiore et inferiore et marginibus pubescentibus, petiolis circiter 5 mm. longis pubescentibus. *Inflorescentiae* axillares, vix maturae, circiter 1 cm. longae. *Calycis* segmenta orbiculari-ovata, acuta vel subacuta, 0·75 cm. longa, marginibus ciliatis. Corolla in alabastro 1·75 mm. longa tubo (?) praecipue immaturo, lobis 1·25 cm. longis linea pilorum transverse notatis. *Antherae* 0·5 mm. longae, barbatae, in tubo insertae. *Ovarium* cum stylo glabrum. *S. Ridleyi*, Dop in Bull. Soc. Bot. Fr. lvii. Mém. 19 (1910), p. 16. et in Flor. Gén. Ind.-Chin. iv. p. 165 partim; non King & Gamble, Mat. Flor. Mal. Penins, iv. p. 831.

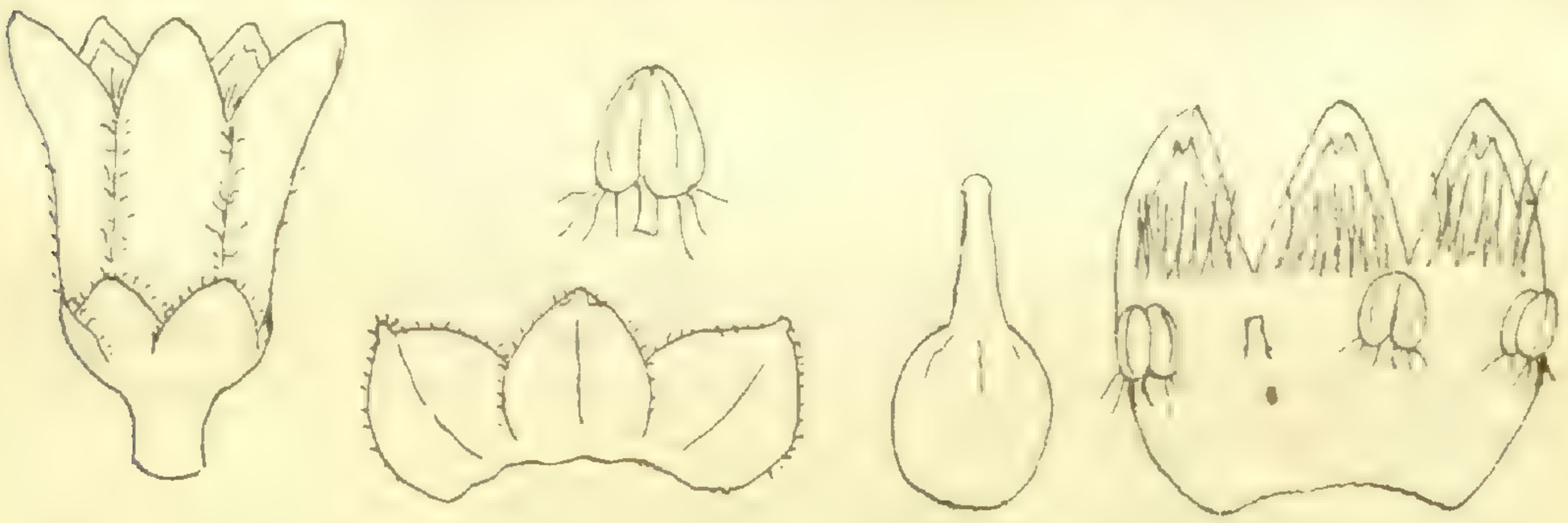
Cochin-China. Prov. Saigon; Thuduc (Apr.), *Pierre* 329. 331 in herb. Mus. Paris.

Dop has referred Pierre's specimens from Thuduc to *S. Ridleyi*, King & Gamble. The plant however is a small tree with thorns, trinerved leaves with margins and median nerves pubescent, and is quite distinct from *S. Ridleyi*.

The specimens from Pak-lay quoted by Dop under *S. Ridleyi* are quite distinct and belong to an undescribed species.

45. **S. plumosa,** *A. W. Hill;* species *S. Ridleyi*, King & Gamble et *S. Schmidtii*, Gilg, affinis, ramis et foliorum nervis dense pubescentibus, corollae tubo lineatim pubescente praecipue differt.

Frutex scandens, lignosus, ramis ramulisque dense et minute pubescentibus. *Folia* ovata vel ovato-cuneata, acuta, basi rotundata, 6-7·5 cm. longa, 3-4 cm. lata, trinervia, coriacea, superne vernicosa, nervis pubescentibus venis inconspicuis, petiolis circiter 5 mm. longis pubescentibus, cirrhis simplicibus. *Inflorescentiae* axillares, corymbosae, compactae, 1·5 cm. longae, multiflorae; pedunculis pedicellisque pubescentibus. *Calycis* segmenta late



ovata, acuta, 0·75 mm. longa, 1 mm. lata, marginibus breviter ciliatis. *Corolla* viridis, 3·25 mm. longa, externe pilis in lineas 5 sub sinubus productas instructa; lobi 1 mm. longi, linea pilorum erectorum ad basin instructi. *Antherae* in tubo insertae, orbiculari-ovatae, 0·75 mm. longae, basi barbatae, filamentis 0·5 mm. longis. *Ovarium* cum stylo glabrum; stylus 1 mm. longus. *Fructus* ignotus.

Siam. Me K'mi; limestone rocks, 270 m., *Kerr* 2372.

This species is allied both to *S. Ridleyi*, King & Gamble, and to *S. Schmidtii*, Gilg. It differs from both in the densely pubescent stem and leaf nerves and in the external lines of hairs on the corolla. These lines of hairs run down the outside of the tube from the sutures between the corolla lobes, and mark out the portions of the tube belonging to each corolla lobe.

46. **S. psilosperma,** *F. Muell.* Fragm. iv. p. 44; vi. p. 131; descr. ampl.

Frutex glaber. *Folia* late ovata, basi abrupte cuneata, apice acuta vel breviter acuminata, 5-7·5 cm. longa, 4-5 cm. lata, glabra, 5-nervia, subtriplinervia. *Inflorescentiae* paniculatae, axillares, 4-7 cm. longae, sublaxae, pedunculis pedicellisque glabris. *Calycis* segmenta orbiculari-ovata, subacuta, 1 mm. longa, glabra vel subglabra, marginibus ciliatis. *Corolla* 4 mm.

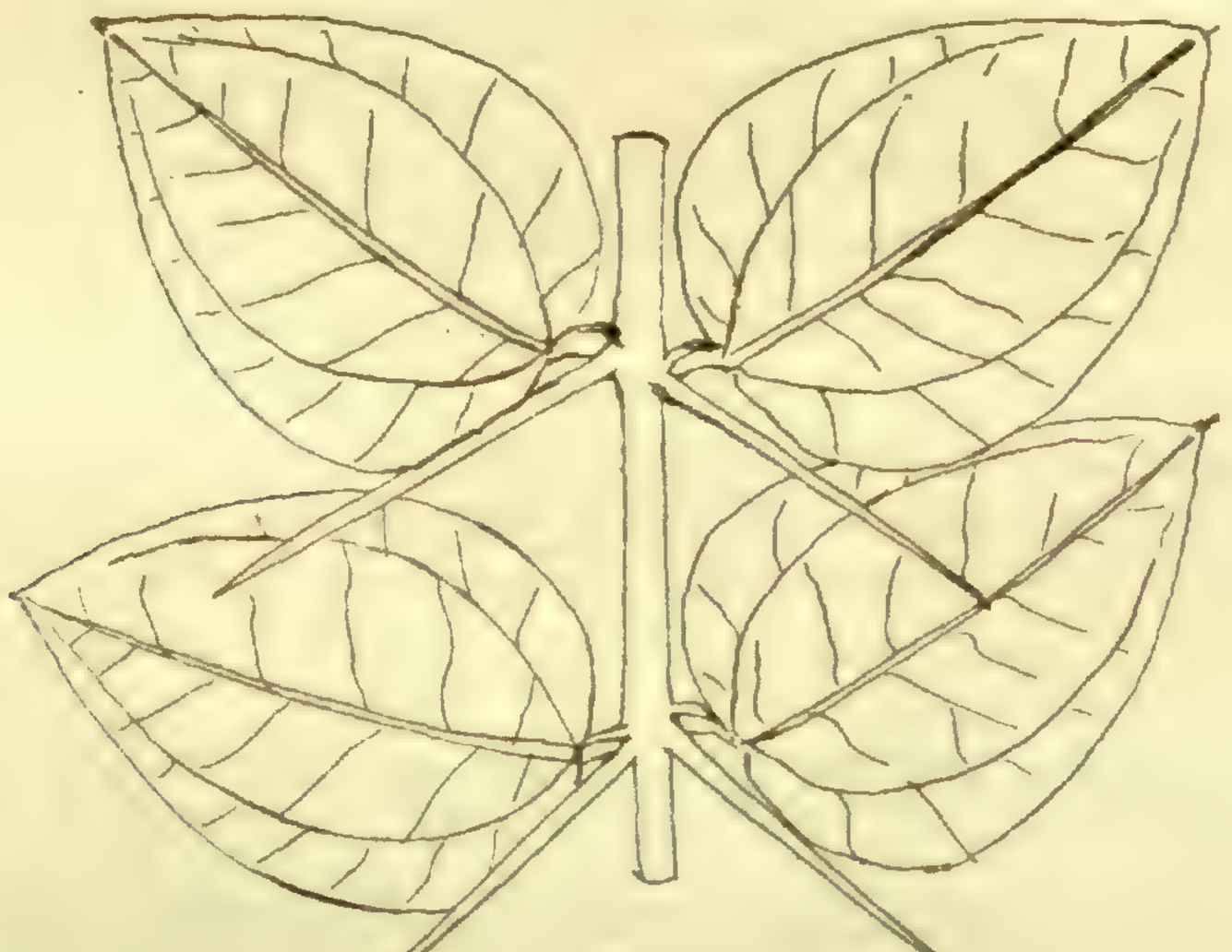
longa; lobi 2 mm. longi, ovato-lanceolati, acuti, intus medio linea pilorum transverse notati. *Antherae* in tubo medio insertae, 1 mm. longae, in latere basi et apice hirsutae. *Ovarium* cum stylo glabrum vel subglabrum; stylus 1 mm. longus. *Bacca* globosa, 0·8-1 cm. diametro, monosperma; pericarpium crustaceum, laeve. *Semen* globosum, glabrum, corneum; Benth. Fl. Austral. iv. p. 369; Bailey, Queensland Flora, iii. p. 1024, partim; Cat. Queensland Woods, p. 59, quoad spec. Trop. Queensland. tantum.

Queensland. Mount Archer, *F. von Mueller*; Edgcumbe Bay, *Dallachy*; Percy Islands, *A. Cunningham*; Percy Islands, *Cunningham* 112; Pine Island, *Tryon*; Rockhampton Dist. *F. von Mueller* 834 in herb. Mus. Brit.; East Coast, *R. Brown* in herb. Mus. Brit. and without collector in Queensland herb.; Eidsvold, *Dr. T. L. Bancroft;* Tooloomba, *F. M. Bailey*.

This species is described by F. von Mueller as "a glabrous shrub with weak but scarcely climbing branches." The plant described by Bailey in the Queensland Flora as "an erect tree 60 or more feet high armed with slender spines 1 in. long" in the Brisbane district proves to be *S. arborea*, A. W. Hill.

47. **Strychnos arborea,** *A. W. Hill*, arbor *S. psilospermae*, F. Muell., similis, sed ramis et foliorum nervis pubescentibus floribus minoribus antheris basi tantum barbatis fructibus minoribus praecipue differt.

Arbor circiter 12 m. alta, inermis (fide *J. L. Boorman*), stirpe 25-30 cm. diametro, ramis et ramulis pubescentibus, ramulis in juventute spinis teretibus glabris acutis 1·5-2 cm. longis supra-axillaribus caducis instructis (fide *J. H. Maiden*



et spec.). *Folia* late ovato-lanceolata vel rhomboidea, basi rotundato-cuneata, apice cuneata, acuta, mucronata, coriacea, marginibus reflexis, circiter 4·5-7·5 cm. longa, 3-5 cm. lata, sub-

trinervia vel triplinervia, pagina inferiore nervis parce hirsutis, venis pinnatifidis et nervo medio conspicuis, petiolis brevibus parce hirsutis. *Inflorescentiae* axillares, compressae, 1·5-2 cm. longae, pedunculis pubescentibus. *Calycis* segmenta triangulari-ovata, acuta, glabra, 0·5-0·75 mm. longa, marginibus ciliatis. *Corolla* 3 mm. longa; lobi 1·75 mm. longi, triangulari-ovati, acuti, crassi, intus ad basin linea pilorum transverse

notati. *Antherae* 0·75 mm. longae, apiculatae, basi barbatae, filamentis paullo sub sinubus insertis. *Ovarium* cum stylo glabrum. *Fructus* globosus, 8 mm. diametro, monospermus; pericarpium crustaceum, tenue, vernicosum. *Semina* glabra. *S. psilosperma*, Maiden & Betche in Proc. Linn. Soc. New South Wales, xxx. pt. iii. 1905, p. 368; Census of N.S. Wales Plants, p. 172; Bailey, Queensland Plants, iii. p. 1024, quoad spec. arborem ex dist. Brisbane.

Queensland. Eumundi; "a small tree" *F. M. Bailey.*

New South Wales. Macpherson Range; Koreelah Peak to White Swamp, *J. H. Maiden*; Acacia Creek, *W. Dunn*; *J. L. Boorman* 205.

This species from New South Wales on the borders of Queensland and from Eumundi about 65 m. north of Brisbane is distinct in being a tree of some 40-60 ft. in height with a trunk 10 in.-1 ft. in diameter. It is further distinguished from *S. psilosperma* by its pubescent stems and the samewhat marked pinnate venation springing from the median nerve of the leaf and also by the sharp axillary spines. The inflorescences are compact, and bear smaller flowers than those of the northern species. A specimen of the timber collected by J. L. Boorman presented to Kew by Mr. J. H. Maiden is remarkably heavy and close grained. The wood is a pale straw-colour with a pitted appearance in transverse section due to patches of interxylary phloem.

The tree is described by Boorman (see Maiden & Betche, Proc. Linn. Soc. N.S.W. l.c.) as a handsome compact tree without any spines (see note under *S. psilosperma*, Muell.), but Mr. Maiden informs me that spines are present on the young shoots and that they disappear as growth proceeds. The specimen of

a young twig he sends from Koreelah Peak bears a sharp supra-axillary spine just above each leaf axil (see fig.).

Thanks to the kindness of Mr. C. T. White, Acting Government Botanist, Brisbane, in sending a specimen of F. M. Bailey's *Strychnos 'psilosperma'* from Eumundi, it is now possible to clear up the difficulties about this plant. It proves to be *S. arborea*, A. W. Hill and not *S. psilosperma*. It was this specimen, no doubt, which caused Bailey to say in The Queensland Flora that *S. psilosperma* in the Brisbane district is "an erect tree 60 or more feet high armed with slender spines 1 in. long."

The following particulars taken from Bailey's catalogue of Queensland Woods* refer to *S. arborea*, though the opening sentence as to the Tropical Queensland shrub refers to *S. psilosperma*.

"286.—*S. psilosperma*, F. v. M., Fragm., iv., 44; Flora Austr., iv., 369. In Tropical Queensland, a rambling shrub; but on Taylor's Range, near Brisbane, a fine erect small tree of 60 or more feet and armed with slender spines 1 in. long. Leaves broadly ovate, 3- to 5-nerved, 1 to 2 in. long; berry globular."

"Wood light-yellow with numerous white longitudinal streaks, the centre black or dark, the grain close; very hard and tough."

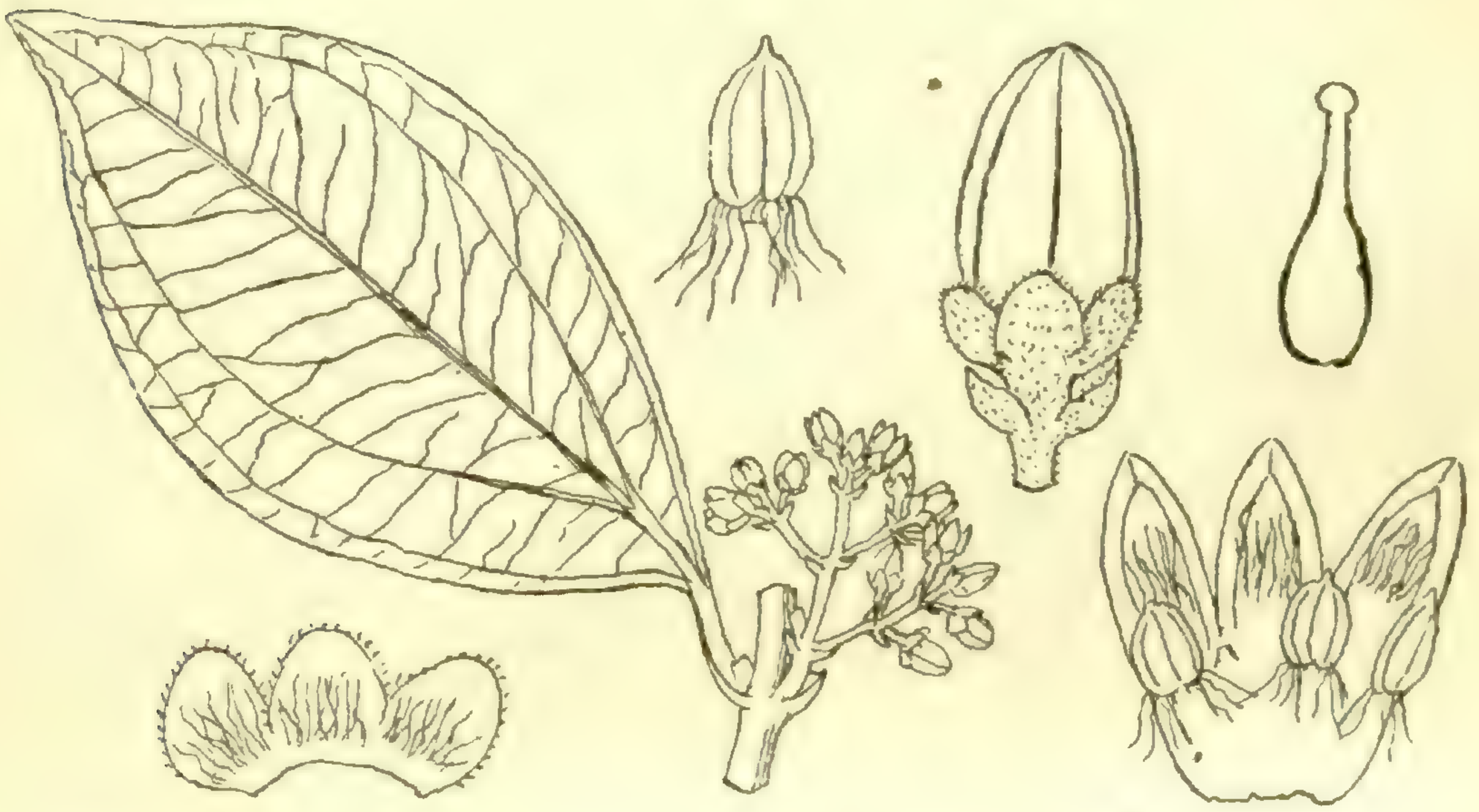
The habitat of this new species is therefore the country around Brisbane to the New South Wales border. The exact northern boundaries are somewhat uncertain, but to the south it does not appear to extend beyond the Macpherson Range.

48. **S. trichocalyx,** *A. W. Hill;* species *S. Dalzellii*, C. B. Clarke, calyce intus hirsuto affinis, sed foliis rhomboideis basi cuneatis floribus minoribus praecipue differt.

Frutex scandens (?). *Caules* in juventute pubescentes, striati, subquadrangulares. *Folia* obovata vel rhomboidea, versus apicem cuneata, acuta vel acuminata, basi cuneata in petiolis angustata, 5-7·5 cm. longa, 3-5 cm. lata, coriacea, superne vernicosa et glabra, marginibus paullo reflexis, pagina inferiore in angulis nervorum saepius hirsuta, 5-nervia, triplinervia, nervis intermediis rectis non curvatis cum nervo medio acutangulos facientibus; petioli 0·5-1 cm. longi, glabri; cirrhi simplices. *Inflorescentiae* axillares, 1-1·5 cm. longae, congestae, pedunculis pedicellisque pubescentibus. *Calycis* segmenta 5, subrotunda, marginibus ciliatis intus ad basin pilis erectis lineatim instructis. *Corolla* 3·5 mm. longa, 5-loba, lobis 2·5 mm. longis ellipticis subacutis crassis, intus supra medium linea pilorum notatis. *Antherae* 0·75-1 mm. longae, orbiculari-ovatae, ad basin et paullo ad margines conspicue barbatae. *Ovarium* cum stylo glabrum, 1·75-2 mm. longum. *Bacca* globoso-ovoidea, circiter 1·5 cm. longa, 1-2-sperma; pericarpium crustaceum. *S. minor*,

* Catalogue of the Indigenous Woods contained in the Queensland Court, Colonial and Indian Exhibition of 1886. By Fredk. Manson Bailey, F.L.S., p. 59.

Benth. var. *nitida*, Benth. in Journ. Linn. Soc. i. p. 101 (non *S. minor*, Blume). *S. colubrina*, Thwaites, Enum. Plant. Zeyl.



p. 201, non Linn.; *S. colubrina* var. *zeylanica*, Clarke in Hook. f. Flor. Brit. India, iv. p. 87; Trimen, Flor. Ceylon, iii. p. 173. *S. micrantha* var. *rhomboidalis*, Dop in Bull. Soc. Bot. Fr. lvii. Mém. 19 (1910), p. 14, quoad spec. Zevlan. tantum.

Ceylon. Galagoma, *Thwaites* 330; without precise locality, *Thwaites* 2516; *Col. Walker* in herb. Wight; *Mrs. Genl. Walker* in herb. Hook. (in herb. Kew); Kandy, *A. Moon* 346; without locality, *Macrae* 197 in herb. Mus. Brit.; Galle, *Pierre* (1865) in herb. Mus. Paris.

A striking species with its rhomboid leaves, conspicuously cuneate or acute towards both base and apex. The specimens at the British Museum have single tendrils so presumably the plant is scandent. It is distinguished from *S. Benthami* by the 5-merous flowers and by the irregular line of erect hairs springing from near the base of the inner surface of the calyx segments as well as by the leaves.

Clarke placed this plant under *S. colubrina*, an unfortunate position since it differs from that species both in the character of the corolla hairs and also in its glabrous ovary. Dop in pointing out the latter difference places it as a variety *rhomboidalis* under *S. micrantha*, a distinct species with woolly corolla hairs; he also adds a plant from Cochin which proves to be *S. Dalzellii*.

The true alliance of this peculiar Ceylon species is no doubt with *S. Dalzellii*, Clarke, from S. India, for not only is there some general similarity in the foliage but the line of internal calyx hairs is found in both species—a feature not seen in any other eastern species of *Strychnos*; in the corolla there is also close resemblance.

According to Trimen this plant is rather common in the dry and intermediate regions of Ceylon.

Attached to the Pierre specimen at Paris is a beautiful series of drawings by E. Delpy (1903) showing the internal calyx hairs of this species.

49. **S. Dalzellii,** *C. B. Clarke* in Hook. f. Flor. Brit. Ind. iv. p. 87; descr. ampl. et emend.

Folia late ovata vel ovato-lanceolata, acuta, basi rotundata vel cuneata, triplinervia. *Inflorescentiae* axillares, corymbosae, 2-2·5 cm. longae. *Calycis* segmenta orbicularia, obtusa, glabra, marginibus minute ciliatis, intus ad basin pilis erectis lineatim instructis. *Corolla* 4-4·5 mm. longa, lobis crassis lanceolatis

2·5-3 mm. longis intus medio linea pilorum erectorum transverse notatis. *Antherae* 1 mm. longae, basi barbatae, filamentis in sinubus affixis. *Ovarium* cum stylo glabrum. *Fructus* (? maturus) globosus, circiter 1·5 cm. diametro; pericarpium crustaceum, 0·25 mm. crassum (*Ritchie* 1867); Cooke, Fl. Bombay, ii. p. 185; Beddome, Indian Trees, p. 474; Dop in Bull. Soc. Bot. Fr. lvii. Mém. 19, p. 14. syn. omn. excl. *S. axillaris*, Dalz. & Gibs., Bomb. Fl. p. 155 non Colebr.; *S. micrantha* var. *rhomboidalis*, Dop, l.c. quoad spec. Cochin tantum.

S. India. Western Mysore; Bababoodun Hills, *Law;* Lóopu West, near Purwur, *Ritchie* 1867; without precise locality, *Dalzell;* Bombay Presidency, *Gibson;* N. Canara, Anmodi, *Talbot* 1622; Cochin, *Pierre* (1878) in herb. Mus. Paris.

Var. **lanceolaris,** *A. W. Hill.* *Folia* anguste lanceolata, acuminata, 7-10·5 cm. longa, 2-3 cm. lata, triplinervia, basi cuneata. *Inflorescentiae* axillares, 1·5 cm. longae, congestae. *Calycis* segmenta orbicularia, marginibus fimbriatis exceptis glabra, intus ad basin pilis erectis lineatim instructis. *Corolla* 3·25 cm. longa, lobis 2 mm. longis crassis intus medio linea pilorum transverse notatis. *Antherae* 0·75 mm. longae, glabrae vel subglabrae. *Ovarium* cum stylo glabrum.

S. India. Manantoddy & Coorg, without indication of collector, in *herb. Mus. Madras;* also scrap attached to sheet 42 *Beddome* from Malabar in herb. Kew. (?)

Dop (l.c.) is incorrect in citing *S. colubrina,* Wall. in Fl. Ind. ii. 264 and A. DC. ix. p. 14 (in part) as synonyms of *S. Dalzellii.* These citations belong partly to *S. cinnamomifolia* var. *Wightii,* A. W. Hill, and partly to *S. axillaris,* Colebr. Dalzell & Gibson mention that their specimens are insufficient to determine whether they should be referred to *S. axillaris,* Colebr. or not. Dalzell's specimen at Kew bears the name "*S. axillaris*" in his own handwriting but it is quite distinct from that species which is a native of Silhet.

50. **S. malaccensis,** *Benth.* in Journ. Linn. Soc. i. p. 101; descr. emend. et ampl.

Caules minute pubescentes. *Folia* ovata vel late ovata, 6-9 cm. longa, 4-5 cm. lata, acuta vel acuminata, basi rotundata, quintuplinervia, nervis exceptis glabra, venis transversis confertis paginis superioribus et inferioribus laevibus, superioribus vernicosis, petiolis nervisque leviter pubescentibus. *Inflorescentiae* axillares, interrupte paniculatae; corymbi laterales circiter 1 cm. longi, multiflori, pedunculis et pedicellis paullo pubescentibus. *Calycis* segmenta triangulari-ovata, acuta, glabra, circiter 0·75 mm. longa, marginibus ciliatis. *Corolla* 2·5 mm. longa, lobis ovatis acutis crassis 1·75 mm. longis medio linea pilorum transverse notatis. *Antherae* ovatae, 0·75 mm. longae, in sinubus insertae, basi dense barbatae et omnino hirsutae. *Ovarium* cum stylo 2 mm. longum, glabrum; stylus 1·25 mm. longus. *Bacca* (*Ridley* 13001) ovoidea, glabra, crustacea, monosperma, 2 cm. longa. *Semina* ovoidea, plana; Miq. Flor. Ned. Ind. ii. pp. 379, 108; C. B. Clarke in Hook. f. Flor. Brit. Ind. iv. p. 89 quoad spec. Malacc. tantum (non *S. Gautheriana,* Pierre); King & Gamble, Mat. Flor. Mal. Penins. iv. p. 828, partim.

Malay Peninsula. Malacca: *Griffith* 3724.

Singapore: Garden Jungle, *Ridley* 13001.

This species resembles *S. penicillata,* A. W. Hill, in its quintuplinerved leaves; they are however quite smooth and not subscabrid with pustules as in that species; only the nerves on both surfaces are slightly hairy. It differs also in the inflorescences and flowers. Clarke placed *S. Gautheriana,* Pierre, from Cochin-China, under *S. malaccensis,* with which it has no near affinity as it belongs to the long-tubed section of the genus. King & Gamble follow Clarke with regard to *S. Gautheriana*

and the mistake is corrected by Dop in his "Contribution to the study of the Asiatic Loganiaceae."*

Another plant placed by King & Gamble under *S. malaccensis* is *Helfer* 3724, which apparently belongs to *S. laurina*. The Penang plant, *King's Collector* no. 1539, also placed under *S. malaccensis* by *King & Gamble* is described as a new species (*S. quintuplinervis*, A. W. Hill, see p. 166), being distinguished from *S. malaccensis* by the more broadly ovate leaves with distant transverse veins, axillary inflorescences, and larger flowers with the anthers included in the corolla tube.

S. malaccensis therefore appears to be confined to the Malacca and Singapore region, and not to extend northwards. It is not closely related to *S. colubrina* as Bentham and Miquel suggest.

51. **S. penicillata,** *A. W. Hill*; species *S. pubescenti*, C. B. Clarke, affinis, sed foliis majoribus late ovatis pustulis munitis inflorescentiis terminalibus antheris in sinubus insertis praecipue differt.

Frutex scandens, omnino pubescens. *Folia* ovato- vel late ovato-lanceolata, acuta vel acuminata, basi rotundata, 6·5-9·5 cm. longa, 3·5-5 cm. lata, 5-nervia, plus minusve quintuplinervia, nervis praecipue pubescentibus omnino pilis pustulis minutis insidentibus; petiolis 5-7 mm. longis. *Inflorescentiae* terminales, corymbosae, multiflorae, 2·5-3 cm. latae. *Calycis* segmenta pubescentia, late ovato-orbicularia, acuta vel subacuta. *Corolla* 4-4·25 mm. longa, externe subpubescens, lobis 2·5-2·75 mm. longis elliptico-lanceolatis acutis vel subacutis intus medio linea pilorum transverse notatis penicillo similibus. *Antherae* ovato-lanceolatae, in sinubus vel paullo sub sinubus insertae, 0·85-1 mm. longae, conspicue apiculatae, ad basin et paullo ad margines barbatae. *Ovarium* cum stylo glabrum, 1·5 mm. longum. *Bacca* ovoidea, 1·5-2 cm. longa, 1-2 sperma; pericarpium crustaceum. *S. pubescens* King & Gamble, Mat. Flor. Mal. Penins. iv. p. 830 partim.

Malay Peninsula. Perak: Larut; 90 m. (Oct.), *King's Collector* 2441; 3623; 6276; 6477; *Scortechini* 1485; Selama, plains, *L. Wray* 4278; Thaiping Waterfall, *Ridley* 3006; Thaiping, *Wray* 3048; *Haniff & Nur* 2401; Kelau Tujor, *Wray* 1916.

Pulau Penang: Government Hill, 600 m., *Curtis* 3649; Muka Head (Aug.), *Curtis* 970.

Negri Sembilan: Perheutian Tuiggi (Dec.), *Ridley* 10089.

This species differs from *S. pubescens*, C. B. Clarke, chiefly in the larger leaves, terminal inflorescences and larger flowers with anthers inserted in the sinuses of the corolla lobes instead of in the tube. King & Gamble's variety of *S. pubescens* named *Scortechini* has been raised to the rank of a species (see p. 168).

52. **S. Wenzelii,** *Merr.* in Philip. Journ. Sc. xi. No. 4. Bot. (1916), p. 202. partim *Ramos* 24381 excl.

Philippine Islands. Leyte; near Tacloban, *Wenzel* 1319, 1569.

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* Bull. Soc. Bot. Fr. lvii. Mém. 19 (1910), p. 17.

The flowers bear a line of erect hairs mid-way across the corolla lobes and the anthers, which are inserted in the sinuses, are bearded at the base. The calyx segments are coriaceous and glabrous with fringed margins. The leaves are large, markedly triplinerved to quintuplinerved, glabrous, brown in the dry state but with both surfaces shining. The nerves are slightly impressed on the upper surface and the veins are fairly conspicuous.

Merrill includes a specimen collected in the neighbouring island of Samar under *S. Wenzelii*, but it is no doubt a distinct though possibly a nearly related species to which the name *S. tesseroidea*, A. W. Hill, has been given. The leaves resemble those of *S. Wenzelii* in general shape and colour when dry, but they are trinerved, the nerves springing from the base of the leaf. Merrill, to include the Samar plant, describes the leaves of *S. Wenzelii* as "5-pli- vel 5-nervia"; "5-nervia" should be omitted from his description. The young stems and the petioles are furnished with hairs and on the back of the leaf the median nerve especially is markedly pubescent, the general surface being glabrous and dull. The main veins are more distant than in *S. Wenzelii*. The fruit of the Samar plant appears to be rather larger, and the seed, which is also horny and glabrous, is about 9 mm. long by 4 mm. broad, being tesseroid in shape with sharp angles (see p. 206). The seed of *S. Wenzelii* is more or less circular in outline and is flattened on one side.

53. **S. Ledermannii,** *Gilg et Benedict* in Engl. Bot. Jahrb. liv. p. 169.

New Guinea. Kaiser-Wilhelmsland: Etappenberg; dense high wood, 850 m., *Ledermann* 8927; 9224; 9435 (Fl. Oct.).

The corolla is 2·5 mm. long with the lobes 1·5 mm. long. The throat is described as being slightly and very shortly hairy, but whether there is a line of erect hairs across the lobes or whether the species should be placed among those with woolly throat hairs cannot be determined from the description. The anthers are glabrous.

54. **S. Horsfieldiana,** *Miq.* in Flor. Ned. Ind. ii. p. 379; A. W. Hill in Kew Bull. 1911, p. 294.

Java. Depok (Buitenzorg), *Koorders* 81; Banyumas, *Koorders* 82 and other specimens cited in *K.B.* l.c.

The calyx segments except for the margins are glabrous. In the corolla the line of hairs occurs about one-third of the way up the lobes and the anthers are inserted in the sinuses.

55. **S. palembanica,** *Miq.* in Flor. Ind. Bot. Suppl. pp. 227, 551; A. W. Hill in Kew Bull. 1911, p. 293. *S. pilgeriana*, Gilg in Notizbl. der Kgl. Bot. Gart. Berlin, 1897, no. 8. p. 268.

Sumatra.

The calyx segments are hairy on the outside. The arrangements of corolla hairs and position of the anthers is similar to that which obtains in *S. Horsfieldiana*.

56. **S. luzonensis,** *Elmer* in Leaflets Philip. Bot. i. (1908), p. 332, partim; descr. emend.

Folia ovato-lanceolata, acuta vel acuminata, basi rotundata, 8-10 cm. longa, circiter 4 cm. lata, 5-nervia, subtriplinervia vel triplinervia, paginae superioris nervo medio tantum pubescente, pagina inferiore glabra, venis omnino eminentibus. *Inflorescentiae* terminales, corymboso-paniculatae, circiter 5 cm. longae. *Calycis* segmenta 0·75 mm. longa, triangulari-ovata,

acuta vel subacuta, marginibus ciliatis. *Corolla* 2 mm. longa, lobis circiter 1·4 mm. longis versus basin linea pilorum erectorum notatis. *Antherae* 0·5 mm. longae, basi barbatae, filamentis 0·5 mm. longis paullo sub sinubus insertis. *Ovarium* globosum cum stylo glabrum, circiter 1 mm. longum; A. W. Hill in Kew Bull. 1911, p. 297. *S. multiflora,* Benth. quoad *Elmer* 7885, A. W. Hill l.c.

Philippine Islands. Luzon: Lucban; Tayabas, *Elmer* 8251; *Curran* 19159.

Elmer has included two different plants in his original description (see A. W. Hill, *K.B.* l.c.). He has also overlooked some interesting features of this species. The leaves are peculiar in that the median nerve only on the upper surface is pubescent while the under surface is glabrous. Then in the flowers there is a line of erect hairs across the corolla lobes near the base. The anther filaments are inserted just below the sinuses, and the anthers are bearded at the base, none of these features being recorded in the original description. In *K.B.* 1911, p. 297 it was suggested that *S. luzonensis* might be allied to *S. multiflora,* but a further study of the flowers shows the error of this view since the corolla lobes are furnished with a transverse line of erect hairs, the anthers are bearded and the ovary glabrous.

57. **S. impressinervis,** *A. W. Hill*; species ex affinitate *S. Wenzelii,* Merr., foliis ovato-lanceolatis acuminatis calycis segmentis late ovatis marginibus membranaceis floribus majoribus praecipue differt.

Frutex scandens (?), ramis in juventate minute pubescentibus. *Folia* ovato-lanceolata, sensim acuminata, 8·5-13 cm. longa, 3-5·7 cm. lata, basi plus minusve rotundata, glabra, in siccitate fusca, pagina superiore vernicosa, inferiore fusco-hebetia, triplivel subtrinervia, nervis paginae superioris impressis venis distantibus inconspicuis; petioli 5 mm. longi, minute

pubescentes. *Inflorescentiae* axillares vel terminales, 1·5-2·2 cm. longae, corymbosae, pauciflorae, pedunculis pedicellisque pubescentibus. *Calycis* segmenta conspicua, late ovata, subacuta, basi rotundata, circiter 2 mm. longa, marginibus membranaceis ciliatis. *Corolla* 4-4·5 mm. longa, lobis 2·25-2·75 mm. longis crassis intus medio linea pilorum erectorum curvatim notatis. *Antherae* ovoideae, 0·75-0·9 mm. longae, basi barbatae, filamentis brevissimis in sinubus insertis. *Ovarium* cum stylo circiter 1·5 mm. longum, glabrum.

Philippine Islands. Palawan: Taytay, *E. D. Merrill* 9401.

This species shows some resemblance to *S. Wenzelii* Merr., from the island of Leyte, but without fruits of either being known it is impossible to say whether there is a very close affinity between them. The Palawan plant is distinct in the dull-brown colour of the under surface of the leaf, the conspicuous widely overlapping calyx segments rounded at the base and in having the pencil or line of erect corolla hairs somewhat curved.

58. **S. mucronata,** *A. W. Hill;* species foliis breviter ovatis emarginatis griseis glabris, inflorescentiis 3-5-floribus distincta.

Frutex scandens, ramis et ramulis tenuibus striatis dense pubescentibus. *Folia* breviter ovata, 3-4 cm. longa, 2-3 cm. lata, apice rotundata, emarginata, mucronata, basi rotundato-cuneata, trinervia, venis reticulatis, glabra, griseo-viridia, marginibus reflexis; petiolis 2-3 mm. longis, cirrhis simplicibus axillaribus hirsutis. *Inflorescentiae* axillares, 3-5-florae, pedunculis glabris. *Calycis* segmenta late orbicularia, subacuta, glabra, marginibus membranaceis ciliatis. *Corolla* immatura circiter 2 mm. longa, lobis 1 mm. longis linea pilorum basi notatis. *Antherae* 0·75 mm. longae, ovatae, basi et secus rimum barbatae. *Ovarium* cum stylo glabrum. *Fructus* ignotus. *S. pubescens,* Dop in Bull. Soc. Bot. Fr. lvii. Mém. 19 (1910), p. 16 et in Lecomte, Flor. Gén. Ind.-Chin. iv. p. 165 partim.

Cambodia. Angcor, *Thorel* in herb. Mus.. Paris, Brit. et Edin.

This is a very distinct species with its small, broadly-ovate, emarginate, trinerved leaves, glabrous and ashy-grey in colour. It is quite unlike *S. pubescens*, C. B. Clarke, though from its flowers it belongs to the same section of the genus.

59. **S. oophylla,** *Gilg et Benedict* in Engl. Bot. Jahrb. liv. p. 170 with figs.

New Guinea. Kaiser-Wilhelmsland: Hunsteinspitze; mossy virgin forest, 1300 m., *Ledermann* 11294 (Fl. Mar.).

The anthers are markedly apiculate, bearded at the base and inserted in the corolla tube. The corolla lobes, judging from the figure, have a line of erect hairs near the base.

60. **S. melanocarpa,** *Gilg et Benedict* in Engl. Bot. Jahrb. liv. p. 172.

New Guinea. Kaiser-Wilhelmsland: Hauptlager Malu on the Sepik; in old secondary alluvial forest, 20-40 m. *Ledermann* 10804 (Fl. Feb.); near Malu, open forest, 50-100 m. *Ledermann* 10861 (Fl. Feb.); Seerosensee Black river, patches of forest, 20-40 m. *Ledermann* 10911 (Fl. Feb.).

61. **S. polytoma,** *Gilg et Benedict* in Engl. Bot. Jahrb. liv. p. 173, with figs.

New Guinea. Kaiser-Wilhelmsland: Hunsteinspitze; Quellenlager, in open rocky primitive forest, 700 m. *Ledermann* 8391 (Fl. August.).

The line of long erect hairs across the bases of the corolla lobes is well shown in the figure. The anthers are inserted in the corolla tube and are markedly apiculate and bearded at the base. This and the preceding closely allied species, appear to be peculiar in this section in having the ovary shortly hairy.

Section iv. **Tubiflorae.**

62. **S. angustiflora,** *Benth.* in Journ. Linn. Soc. i. p. 102; descr. emend.

Frutex scandens, cirrhis simplicibus. *Folia* trinervia. *Corolla* 0·95-1 cm. longa, lobis reflexis 5-5·5 mm. longis ad basin et tubo ad faucem laneo-hirsutis. *Antherae* 1·75 mm. longae, subversatiles, filamentis 4 mm. longis. *Ovarium* glabrum, stylo 8 mm. longo glabro. *Fructus* globosus, 3·5-4 cm. diametro; pericarpium crustaceum, tenue. *Semina* 1-2, orbicularia, 1·1-1·3 cm. diametro, plana, margine acute

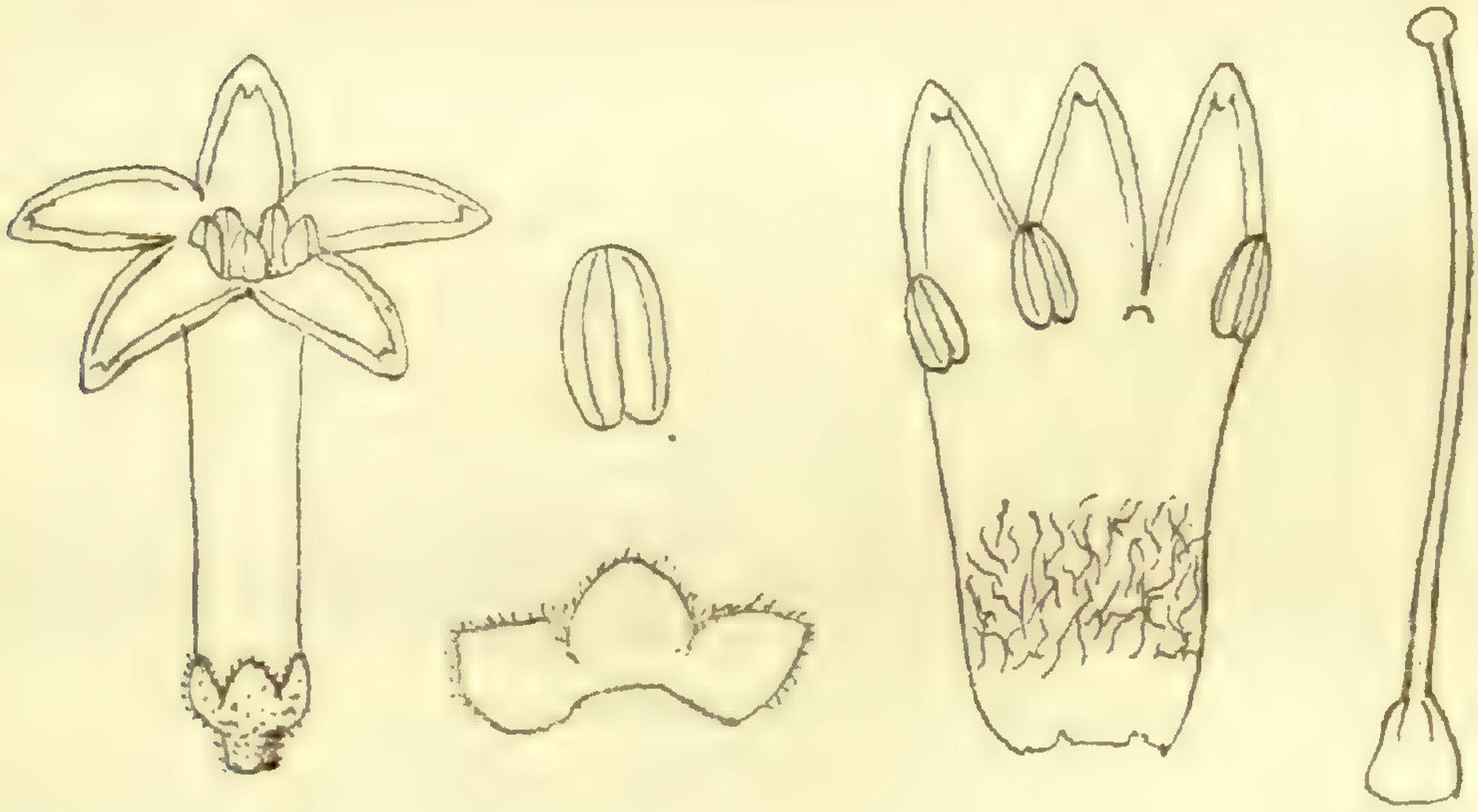
carinato ambitu instructa indumento contexto obtecta. Benth. Flor. Hongk. p. 232; Forbes & Hemsley in Journ. Linn. Soc. xxvi. p. 121 et Ind. Flor. Sin. ii. p. 121; Walp. Ann. v. p. 508; Dop in Bull. Soc. Bot. Fr. lvii. Mém. 19 (1910) p. 15. *S. colubrina*, var. ? Benth. in Hook. Kew. Journ. Bot. v. p. 56; Dunn & Tutcher, Flora of Kwantung and Hong Kong, Kew Bull. Add. ser. x., 1912, p. 174.

China. Hongkong. *Champion* 197, 438; *Urquhart* (1861); *Hinds* 1847; *Wright* 268, 268a, 269; *Wilford* 353; *Beechy* in herb. Univ. Glasgow; *Weiss*, *Hance* in herb. Mus. Paris.

The inflorescences terminate leafy axillary shoots as in *S. Nux-vomica*. The corolla is long and cylindric but, owing to splitting, the lobes are equal in length to the tube. The fruits are 3·5-4 cm. in diameter, like a small orange and full of pulp with a thin, smooth, crustaceous pericarp. One or two seeds are borne in the fruit and they resemble those of *S. Nux-vomica* in being circular and flattened with a sharpened edge. They measure from 1·1-1·3 cm. in diameter and are covered with a dense felt of short hairs. It is not recorded whether the seeds contain any appreciable quantity of strychnine or other alkaloids.

Mr. Tutcher, Superintendent of the Botanical and Forestry Department. Hongkong, informs us that *S. angustiflora* is known by some of the Chinese as the 'Ma tsien tsze' plant; this being the Chinese name for *Nux-vomica*.

63. **S. Nux-vomica**, *Linn.* Spec. 271; G. Don, Dict. iv. p. 65; Clarke in Hook. f. Flor. Brit. Ind. iv. p. 90—syn. Kurz, For. Flor. ii. p. 166, *S. lucida*, Wall. Cat. 1590 et loc. Tenasserim excl.; Bedd. Fl. Sylv. ii. t. 243 et Brandis, Indian Trees, p. 473, spec. Burm. excl.; Trimen, Fl. Ceylon, pt. iii. p. 175; Dalz. & Gibs. Bombay Flora, p. 155; Benth. in Proc. Linn. Soc. i. p. 103, spec. ex Moluccis excl.; Miq. Flor. Ned. Ind. ii.



Details of flower of *S. Nux-vomica* for comparison with those of *S. Nux-blanda*.

p. 378 partim; Cooke Fl. Bombay ii. p. 185; Dunstan & Short, Pharm. Journ. xv. ser. iii. p. 1 et Icon.; Dop in Bull. Soc. Bot. Fr. lvii. Mém. 19 (1910), p. 18 spec. Birman. *Anderson, Pierre* 3693 et var. *grandiflora* excl.; Dop in Lecomte, Flor. Gén. Ind.-Chin. iv. p. 168 spec. Siam., spec. *Pierre* (sub var. *oligosperma*), et var. *grandiflora* excl. Bourdillon, Forest Trees Travancore, p. 269; non Kurz, For. Fl. Brit. Burma, ii. p. 166; non Craib in Kew Bull. 1911, p. 421. *S. Nux-vomica* var. *oligosperma*, Dop in Bull. Soc. Bot. Fr. lvii. Mém. 19, p. 18 et in Lecomte, Flor. Gén. Ind.-Chin. iv. p. 169 spec. ***Pierre*** **excl.**

India. Madras: Travancore: Bengal.

Ceylon.

Indo-China. Cochin-China: *Pierre* 3689; Lefèvre 385; *Thorel* 1026 in herb. Mus. Paris; *Jumelle* (semina) in herb. Kew. Cambodia spec. ex *Jumelle* in herb. Kew. Laos: *Thorel* in herb. Mus. Paris.

An examination of the rich material of *S. Nux-vomica* from Calcutta brought to light the interesting fact that *S. Nux-vomica*, Linn. is confined to India and Ceylon and that the Burmese plant hitherto referred to this species is quite distinct. The differences are pointed out in the note under *S. Nux-blanda*, A. W. Hill, which may perhaps be considered the eastern representative of *S. Nux-vomica*.

The fruit of the true *S. Nux-vomica* varies in size from that of a large to a small orange, according to Dunstan & Short l.c. A diameter of 5·6 cm. appears to be exceptional, and more usually they are about 3·5-4 cm. in diameter. The number and size of the seeds is also variable, 4 being the average number of good seeds. The circular button-like seeds with their satiny coats are easily distinguished from those of *S. Nux-blanda*.

The seed figured in Hortus Malabaricus, viii. t. 24, is very like that of *Nux-vomica*, and it is possible that the fruits and seeds of the three Malabar species were mixed by the early collectors (see under *S. Rheedii*, p. 208).

Roxburgh's note attached to *S. Nux-vomica* inserted by Carey under the description of *S. colubrina* (Fl. Ind. ii. p. 264), may refer either to a form of *S. Nux-vomica* or to *S. potatorum* as these are the only two tree species of *Strychnos* known from the eastern side of India. Don (Dict. iv. p. 65), quotes Roxburgh's note under *S. colubrina* giving the locality Coromandel, no doubt to include Roxburgh's unknown tree.

As to the occurrence of *S. Nux-vomica* in the wild state in Indo-China considerable doubt has existed and Dop's account is not very helpful, especially when it is found that some of the specimens cited do not belong to *S. Nux-vomica* and that his variety *grandiflora** must be referred to *S. Nux-blanda*.

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* Dop. in Bull. Soc. Bot. Fr. lvii, Mém. 19, p. 18.

Loureiro however (Fl. Cochin. i. (1790) p. 125), gives the habitat of this tree as the woods of the province of Binh Klang and De Lanessan* states that it is common in some parts of Cochin-China, adding that its vernacular name is "Cay-cu-chi."

According to Garnier (Indo-Chine, ii. p. 429), *Nux-vomica* is largely exported from Cambodia to China, and Niederlein, "Ressources végétales des Colonies Françaises" (1902, p. 56), also mentions that seeds of *S. Nux-vomica* are represented from Cambodia and Cochin-China in the collection of the Minister of the Colonies in Paris.

There can be no doubt therefore that *S. Nux-vomica* grows in Cochin-China but whether it is really indigenous or the result of introduction is somewhat difficult to determine.†

The wide gap in the distribution of the species does however suggest that the occurrence of the plant in French Indo-China may be due to some early introduction from Ceylon or India and the long-known medicinal properties of the seeds lends some further support to the view that it may have been introduced by early traders or missionaries voyaging from Ceylon or S. India to the East.

Mager (Atlas Colonial, 1885, p. 1), in his description of Cambodia refers to the ancient intercourse between Ceylon and Cambodia, the earliest record of which appears to be the introduction of Buddhism from Ceylon in the IVth Century. It may be that about that time or on some later occasion *Nux-vomica* was brought from Ceylon and that its cultivation was taken up on the granitic hills of Cochin-China whence most of the specimens now recorded from the country have been derived.

The drug has been known to the Chinese for a long time, and it is possible that Nux-vomica seeds may have reached China by another route, for F. P. Smith in his Contributions towards the 'Materia Medica & Natural History of China,' 1871, p. 156 (which Bretschneider remarks is a mine of scientific confusion), states that *Nux-vomica* "is brought from Sech'uen, but it originally came from some Mohammedan country in Central

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* "Les Plantes utiles des Colonies Français," Flore Cochin. p. 776 (Paris, 1886).

† The following letter from Prof. H. Jumelle, Director, Colonial Museum, Marseilles, is of interest in this connection:—

"Toutes les publications sur la flore ou sur les produits de Cochinchine indiquent, en effet, le *S. Nux-vomica* comme indigène, mais j'ignore s'il y a eu un controle bien sur à cet égard et s'il ne s'agit pas d'une erreur répétée par tous.

"En tout cas, aucune statistique douanière aussi bien indo-chinoise que française ne mentionne une exportation des noix vomiques. Mais elles peuvent être comprises sous la rubrique générale: *Espèces medicinales*, etant donné le pas d'importance de ce mouvement.

"M. Brenier, ancien directeur des services agricoles de Cochinchine et chef de la statistique que j'ai consulté à ce sujet, ne possède aucune donnée sur ce commerce, et c'est cependant certainement la personne la plus documentée sur ces questions.

"Voilà malheureusement tout ce que je puis vous dire; il s'agirait tout au plus d'un commerce très secondaire."

Asia."* Soubeiran & Thiersant, 'La Matière médicale chez les Chinois,' 1874, p. 176, possibly copying from Smith, to whom they refer, state that *Nux-vomica* was introduced into China from the Mohammedan countries of Central Asia. Should these two references be reliable it would indicate that the seeds of *Strychnos Nux-vomica* entered China by way of the caravan routes of Central Asia, possibly via Khabul. But this would not preclude the possibility that they also found their way to China by the sea route from Ceylon or S. India, which is no doubt the principal trade route for the seeds at the present day. In an earlier French account of Chinese Pharmacy by M. Debeaux† it is recorded under "*ma-tsien-tze* semences de Noix-vomique," 'La noix-vomique est introduite depuis longtemps

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* The following letter received from Mr. W. J. Tutcher, Superintendent, Botanical and Forestry Department, Hongkong, is of interest with reference to the statement that *Nux-vomica* comes from Szechuen—

"Seeds of *Strychnos Nux-vomica* can be purchased in the local Chinese drug shops, but all the information obtainable from the sellers is that they get them from Szechuen.

"The province of Szechuen has a great reputation for vegetable drugs amongst the Chinese, and probably this is the reason the Chinese druggists say they get the seeds from that province.

"Another reason why they say they come from Szechuen is that seeds of *Momordica cochinchinensis* are often sold as *Strychnos* seeds, and it is possible that the *Momordica* seeds do come from that place, although I have no information on the subject.

"Since receiving your letter, on sending for *Strychnos Nux-vomica* seeds, I obtained seeds of the *Momordica*.

"In Porter Smith's 'Materia Medica of China,' p. 156, you will notice that the Chinese names of *Nux-vomica* are given as *Fan-muh-pieh* and *Ma tsien tsze*. Porter Smith also mentions, at the same place, that seeds of *Muricia* (*Momordica*) are often confounded with *Strychnos*.

"In Hanbury's Science Papers, p. 230, the Chinese names of *Muricia* (*Momordica*) are given as *Muk-pee-tsze* and *Fan-muh-pee*.

"The seeds I have just obtained [*Momordica*] were supplied as those of *Strychnos*, but with the Chinese name of *Muh-pee-tsze*.

"This is undoubtedly the proper Chinese name for these seeds.

"In the foregoing Chinese names *fan* means foreign and *tsze* means seeds.

"The correct Chinese name of *Strychnos Nux-vomica* seeds is certainly *Ma-tsien-tsze*.

"I am informed by the Imports and Exports Office, Hongkong, that seeds of *Momordica cochinchinensis* are imported as *Strychnos Nux-vomica* seeds under the name of *Muk Pit Tsze* from Annam and Haiphong.

"Seeds of *Strychnos Nux-vomica* were (and still are) obtainable in Hongkong, and it is probable that they come from India.

"In a note I have received from Mr. A. N. Pullen, Government Apothecary, Hongkong, he says '*Momordica cochinchinensis* seeds are certainly poisonous and appear to contain alkaloids similar to if not identical with those contained in *Strychnos Nux-vomica*.'

"Some of the Chinese druggists say that *Ma tsien* seeds can be obtained from plants growing in Hongkong, but so far I have been unable to obtain any of these seeds from the druggists.

"It is quite probable that they refer to seeds of *Strychnos angustiflora*, as the seeds of this plant are hardly distinguishable superficially from seeds of *Strychnos Nux-vomica* except that they are smaller.

"I know that *Strychnos angustiflora* is known by some of the Chinese as the *Ma tsien tsze* plant."

† Debeaux, J. O. Essai sur la Pharmacie et la matière médicale des Chinois, 1865.

dans la matière Médicale Chinoise, ainsi que la fève Saint-Ignace." St. Ignatius Beans from the Philippines of course came by sea and there can be little doubt that *Nux-vomica* also has largely been carried by trading junks to Hongkong or some other Chinese port.

It is curious that, though *Nux-vomica* appears to have long been known to the Chinese, Bretschneider makes no reference to the drug.

It is therefore impossible to say how *Nux-vomica* first became known to the Chinese, and whether it is really indigenous in Cochin-China or, as seems more probable, that it has been introduced there by human agency.

Prof. H. Jumelle, Director of the Colonial Museum, Marseilles, has very kindly sent samples of "*S. Nux-vomica*" seeds from Cochin-China and from Cambodia to Kew, and the seeds are certainly those of true *Nux-vomica*.

Prof. Greenish, of the Pharmaceutical Society, London, who has kindly examined the two samples of seeds, informs me that the alkaloids Strychnine and Brucine occur in about normal proportions in both samples. In this connection it is of interest to recall the following paragraph from a letter written by M. Pierre, from Saigon, to Sir Joseph Hooker, which is published in the *Kew Report*, 1877, p. 31:—

"The bark of *Strychnos Nux-vomica* is regarded in Cambodia and Siam as a poison no less certain than that extracted from the seeds. The natives have remarked the fact, which is also believed to hold good in the case of Cinchonas, that the bark has the most powerful properties when it has been covered with moss or otherwise protected from the action of light. In collecting the bark great attention is paid in consequence to the circumstances under which it has been produced."

From an examination of the species of *S. Nux-vomica* from Indo-China preserved at Paris there would appear to be no reason for maintaining Dop's variety *oligosperma* as both the size of the fruit and the number of seeds tends to be variable. The leaves in some of the specimens differ a little from those of the Indian collections, but the French material is insufficient for precise determination.*

French Indo-China appears to be a centre for species of *Strychnos* showing affinity to *S. Nux-vomica*, of which at present our knowledge is very meagre. Among these may be mentioned *S. donnaiensis* from S. Cochin-China (*Pierre* 3692); a subscandent plant with leaves not unlike those of some of the plants from this region assigned to *S. Nux-vomica* and with very similar seeds (see Dop l.c. p. 20). *S. usitata*, Dop, again, has

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* *Pierre* 3693 placed by Dop under his variety *oligosperma* has elliptic leaves and is apparently a climbing plant. It is certainly not *S. Nux-vomica* but may be related to *S. Pierriana*.

In Pierre's specimen No. 3689, the fruit is 4 cm. in diameter and contains two seeds. Owing to the few seeds he was doubtful if the plant were really *S. Nux-vomica*. Dop in his description of the fruit (see Lecomte, Flor. Gen. Ind.-Chin. iv. p. 168) gives 15 as the maximum number of seeds in a fruit of 4 cm. in diameter! This error is no doubt due to his inclusion of *S. Nux-blanda* as his var. *grandiflora*.

the familiar button-shaped *Nux-vomica* seeds but they are only slightly hairy with a rufous tomentum and *S. rupicola*, Dop, another subscandent species with immature flowers is evidently allied either to *S. Nux-vomica* or to *S. Pierriana*.

S. Nux-vomica also shows affinity with *S. angustiflora*, Benth., especially in its fruits and seeds and it is possible that this relationship may be traceable to a former widespread distribution of a primitive species of which *S. Nux-vomica* in India, Ceylon and Cochin-China (?)—*S. Nux-blanda* in Burmah and Siam, *S. angustiflora* in Hongkong, and *S. ligustrina* and *S. lucida* in Timor and N. Australia may be the scattered derivatives.

No particulars can be discovered as to whether the Indo-Chinese *Nux-vomica* is an article of any commercial value as no statistics appear to have been published; neither is any light thrown on the subject from the Imports and Exports Office, Hongkong.

Commercial *Nux-vomica* apparently comes almost entirely from India, and the following figures taken from the Account of the Exhibits in the Agricultural Section of the Agricultural products of the Madras Presidency (1917) pp. 29-30 are of interest:—

Nux-vomica.—*Foreign Trade.*—Separate figures prior to 1912-13 are not forthcoming.

Figures of quantities in thousands of hundredweights—000 omitted.
Figures of value in thousands of rupees—000 omitted.

Year.	Quantity in thousands of hundredweights.	Value in thousands of rupees.	Chief countries which take the produce and percentage of exports (average of recent normal years) thereto.
1912-13	29	1,51	America (United States of America), 44 per cent.; United Kingdom, 37 per cent.; Belgium, 14 per cent.; Holland, 4 per cent.
1913-14	34	1,90	
1914-15	25	1,56	

Chief ports of export, average proportionate share of trade, methods of packing and chief months of export.

Port.	Proportionate share.	Chief months produce available.	Methods of packing.
	Per cent.		
Cochin ...	28	December to April	*Single gunny bags of 140 lb. net.
Madras ...	27	December to June	Single gunny bags of 164 lb. net.
Cocanada	23	January to June...	Occasionally Madras ships in 175 lb. bags.

* Trade is from various ports on the coast and proportions between ports fluctuate.

Grades of quality and prices in typical months.—Shipped against fair general average of season most usually Europe cleaning. It is claimed that West Coast produce is "bolder" than the East Coast.

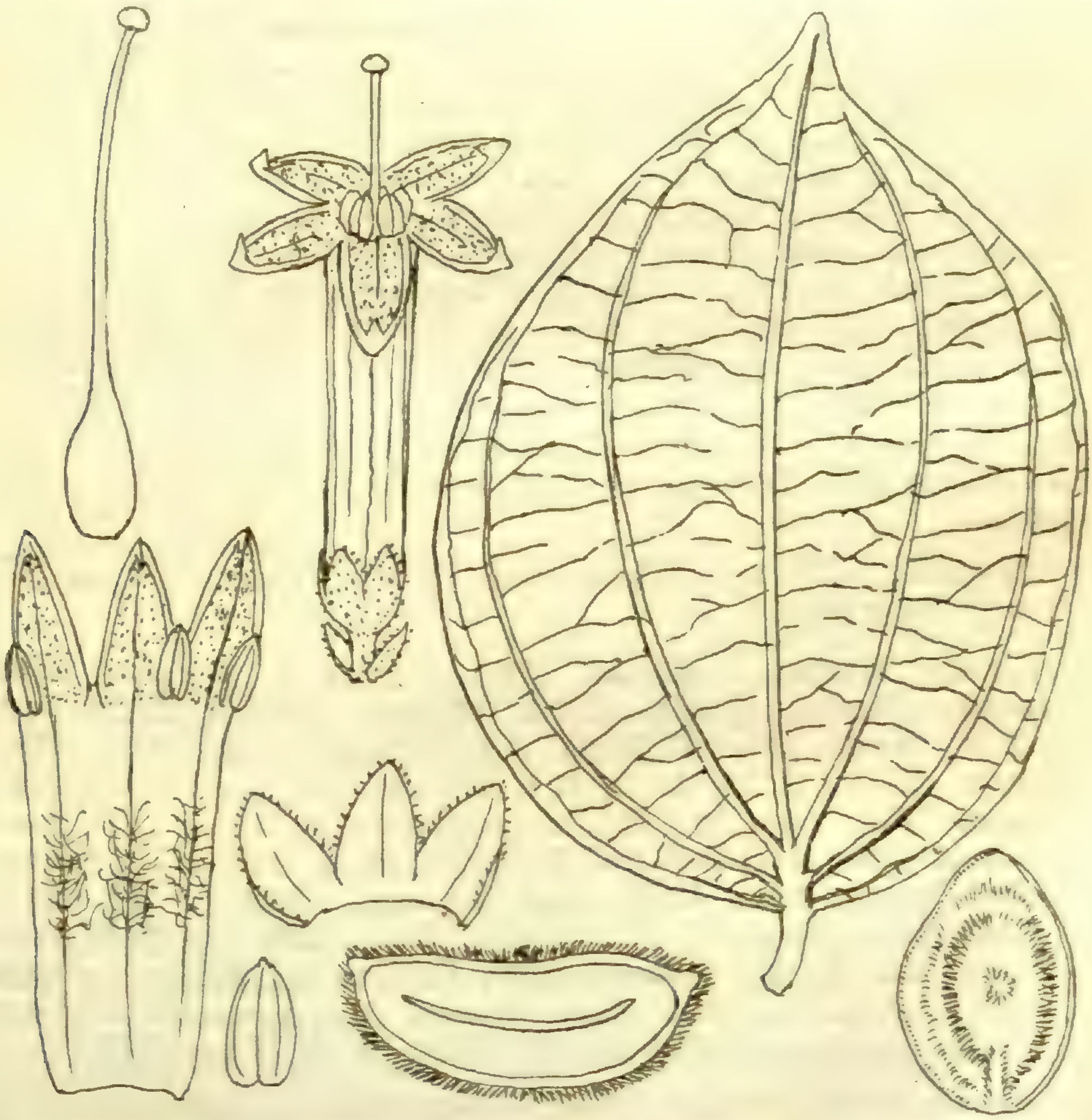
Prices—

	May, 1914.	May, 1916.
Cochin	£9	£15 a ton f.o.b. Cochin (tonnage teak Cochin 16 cwt.).
Madras	£12	£22 a ton c.i.f. London.

Freight Madras to London in 1914 was £1 17s. 6d. a ton.
Freight Madras to London in 1916 was £8 17s. 6d. a ton.
New York takes nearly all the Cocanada output.

64. **S. Nux-blanda,** *A. W. Hill*; species cum *S. Nux-vomica*, Linn., confusa et ei affinis, foliis grandibus abrupte acutis vel acuminatis, calycis segmentis lanceolatis, antheris apiculatis in tubo corollae insertis seminibusque dissimilibus praecipue differt.

Arbor parva, usque ad 15 m. alta (*Prazer*) vel frutex in locis elatioribus circiter 8 m. altus; rami glabri, cortice vernicoso obtecti. *Folia* late ovata vel elliptico-ovata, abrupte acuta vel acuminata, basi rotundata, rotundato-cuneata vel nonnumquam



The leaf is half natural size and the section of the seed is enlarged.

paullo cordata, 11-22 cm. longa, 7-16 cm. lata, glabra, superne vernicosa, tri- vel paullo triplinervia, 5-7-nervia, nervis pagina superiore paullo impressis pagina inferiore conspicuis paullo hirsutis vel glabris, venis primariis conspicuis, reticulationibus omnino plus minusve inconspicuis; petioli 1-1·5 cm. longi. *Inflorescentiae* corymboso-paniculatae, pauciflorae, 4-6 cm. longae, 2·5-4 cm. latae, ramulos axillares bi- vel 4-foliatos terminantes; pedunculi glabri vel subglabri; pedicelli papillosi vel minute pubescentes. *Calycis* segmenta anguste elliptico-lanceolata, acuta, 1·3-2 mm. longa, subglabra, marginibus ciliatis. *Corolla* alba, 1·1-1·2 cm. longa, lobis circiter 3·5 mm. longis elliptico-lanceolatis intus paullo rugoso-papillosis glabris, tubo versus basin pilis longis paullo hirsuto. *Antherae* 1·75-2 mm. longae, apiculatae, subsessiles, paullo sub sinubus insertae. *Ovarium* glabrum; stylus 0·9-1·2 cm. longus, glaber. *Fructus* globosus, 6-8 cm. diametro; pericarpium vernicosum, verruculosum, lignosum, 2-2·5 mm. crassum. *Semina* circiter 8-12, irregulariter ovoidea vel subrotundata, 1·8-2·3 cm. longa, 1·4-2 cm. lata, 6·5-8·5 mm. crassa, subcompressa, margine acute carinato ambitu instructa, indumento contexto hebete obtecta. *S. Nux-vomica*, Griffith, Icones Pl. Ind. Or. t. 411. figs. 2; Notulae, iv. p. 82; Private Journals, p. 84; A. DC. in DC. Prod. ix. p. 15 quoad spec. ex Cochinchin. (?); Kurz Rep. For. Veg. Pegu (1875), Append. A. p. xci., Append. B. p. 68; Kurz Flor. Brit. Burma, ii. p. 166; Clarke in Hook. f. Flor. Brit. Ind. iv. p. 90 quoad spec. ex Tenasserim et syn. Kurz; Craib in Kew Bull. 1911, p. 421 quoad spec. Siam.; Brandis, Indian Trees, p. 474 quoad spec. ex Burm.; Collet & Hemsley in Journ. Linn. Soc. xxviii. (1891), p. 90; Watt, Dict. Econ. Prod. Ind. vi. pt. iii. p. 379 quoad spec. Burm.; Dop in Bull. Soc. Bot. Fr. lvii. Mém. 19, p. 18 quoad spec. Birm. Anderson. Var. *grandiflora*, Dop in Bull. Soc. Bot. Fr. lvii. Mém. 19 (1910), p. 18 et in Lecomte, Flor. Gen. Ind.-Chin. iv. p. 168 quoad *Spire* 793. *S. acuminata*. Wall. Cat. 1593 (3), A. DC. in DC. Prodr. ix. p. 14; Brandis, Indian Trees, p. 475 partim.

Manipur. Khongal Thannah & Kaboo Valley, 210 m. (Fr. Feb.), *Watt* 6628.

Upper Burma. Bhamo Dist.; Bhamo, *Griffith* 3723; towards Camein, *Griffith* 3722; Bhamo, *Burkill* 22795 herb. R.E.P.; Katha, *Burkill* 22485 herb. R.E.P.; Ruby Mines Div., Mogok, *Walsh* 27292 herb. R.E.P.; Shwegu *Asst. Conservator Forests* 27633 herb. R.E.P.; Upper Chindwin, Tamu (Fr. Dec.), *Meebold* 7589; Kachin Hills, Metkina *Shaik Mokim* 16; Kalawa Hills, *Prazer;* Shan Hills, Fort Stedman, 1200 m. (Fl. May), *Collett* 676; *King's Collector* 456; Heho, 900 m., *Collett* 59; Madoe Hill, *King's Collector* 204; Yunnan Expedition, without locality, *D. J. Anderson*; Shan Plateau, Maymyo station, *Prazer* 30; Maymo plateau, 1050 m. (Fl. May), *J. H. Lace* 6169.

Lower Burma. Pegu Dist.: Pegu Yomah; Martaban, *Kurz* 574; Pegu, *Col. Eyre* (1857); *Brandis* 680 *in herb. Sulp. Kurz*; Moulmein, *Falconer* 772; *Wallich* 1586 b (1807); Atran

Wallich 1586 a; Atran *Wallich* 1593· (3) *in herb. Wallich;* Zamayi forest *Anthony* 26030 herb. R.E.P.; Rangoon, *Cleghorn* 93; Rangoon, Tenasserim circle, *Conservator of Forests* 31718, 36721 herb. R.E.P.; Prome, *Hauxwell* 27817 herb. R.E.P.; Pyinmang, *Smales* 27378 herb. R.E.P.

Amherst Dist.: Thingau-nyi-nawny, *Burkill* 24412, 24419 herb. R.E.P.

Tenasserim: Chounguas; 1200 m., *Gallatly* 535.

Southern Shan States: Near Laikan; 840 m., *Scott* 29509 herb. R.E.P.

Siam. Prae; 150 m. (tree), *Luang Vanpruk* 460; 180 m. (shrub), *Luang Vanpruk* 197; Chiengmai, 300-600 m. (small tree or shrub fl. Apr.), deciduous jungle, *Kerr* 603.

Indo-China. Laos: Luang Phrabang; *Spire* 793 in herb. Mus. Paris.

Vernacular names.—Burmese. Khabaung, Kabaung. *Shan.* Maktiing, Khapundee (*Burkill*). *Karenni.* Diterse. *Siam.* Tung Ton. *Laos.* Kok-toung-ki.

1074 Var. **hirsuta,** *A. W. Hill. Arbor* parva, 2-4 m. alta (*Pierre*). *Rami* et ramuli pubescentes. *Folia* late ovata, abrupte subacuta, basi late rotundata vel subcordata, 9-18 cm. longa, 5-15 cm. lata, 5-7-nervia; nervi pagina superiore sulcati, subpubescentes, inferiore prominentes, cum venis dense pubescentes. *Fructus* magnus, globosus, 5-6 diametro. *Semina* numerosa, usque ad 15 (*Pierre*). *S. Nux-vomica* var. *grandiflora,* Dop in Bull. Soc. Bot. Fr. lvii. Mém. 19, p. 18 et in Lecomte, Flor. Gen. Ind.-Chin. pt. iv. p. 169 partim.

Indo-China. Cochin-China: Bien-hoa, *Thorel.* Cambodia: Prov. Samrong-tong; Mt. Rancon, *Pierre* 3687.

Griffith in his drawing shows the character of the narrow lanceolate calyx segments very clearly and also the apiculate anthers which are inserted below the sinuses of the corolla lobes. In his notes he mentions that the tree is common in patches of jungle. His specimens at Kew are not specifically named, but in his Icones they are referred without question to *S. Nux-vomica,* Linn.

This new species, which is known in Burma as 'Khabaung,' is widely distributed throughout Upper and Lower Burma as far south as Tenasserim and extends westwards to Manipur and eastwards into Siam and Laos, with a variety in Cochin-China and Cambodia. It is as a rule a small tree according to Prazer's label, reaching a height of 50-60 ft. in the Kalawa Hills. A more normal height appears to be 20-40 ft. with trunk some 2 ft. in diameter. When collected at altitudes of about 4000 ft. it is said to be a low tree or a shrub. It appears to be fairly frequent and is found in some places as a common tree in the half-deciduous forests and it has been collected by Kerr in deciduous jungle on Doi Sutep. Kurz states that 'Ka-pung' is a tree 30-40 ft. high and grows in the leaf-shedding forests, and Mr. Lace writes that it is scattered about the deciduous forests of Burma. It is remarkable for its large abruptly acute or acuminate leaves with their prominent strong

nerves and inconspicuous veins, characters which enable it to be easily distinguished from *S. Nux-vomica*. With these characters and the fairly thick sharp-edged seeds, irregular in shape and furnished with a felt-like covering—quite unlike the satiny coat of the round, flattened, button-like seeds of *S. Nux-vomica**—it is surprising that 'Khabaung' should so long have been confused with the well-known species. It does not appear that the seeds have ever been commercially exported as '*Nux-vomica*,' and had this been attempted it seems hardly likely they would have been accepted by the dealers since their appearance is so different from the commercial product.†

As to the present uses of the tree, Burkill notes on his specimen from Bhamo that "Shans eat the pulp but not the seed," and Scott on his specimen 29509, from the S. Shan States, says that it is "used only as a vegetable by the natives here," but he does not indicate the part used.

Watt (Dict. Econ. Prod. India, vi. p. 382) mentions, under *S. Nux-vomica*, that in Burma the wood is used for making carts and agricultural implements and for fancy cabinet work. This statement clearly refers to the wood of *S. Nux-blanda*.

In the flowers the most striking difference between *S. Nux-blanda* and *S. Nux-vomica* is to be found in the calyx segments which are long and narrowly lanceolate, whereas in *S. Nux-vomica* they are shortly and broadly ovate. The anthers in the new species are apiculate and inserted below the sinuses; in both these respects they differ from those of *S. Nux-vomica*, where the insertion is in the sinuses and there is no apiculus.

As regards the fruits, they are as a rule larger than those of the Indian *S. Nux-vomica* and contain a greater number of seeds. If the seeds with the single fruit specimens, collected by Forest Officers in the Tenasserim circle, Burma, were derived from a single fruit there are some 8-12 or more seeds in a fruit and the seeds from one fruit weigh about half an ounce.

It is interesting to be able at last to assign to its proper place the Wallichian specimen 1593 (3)‡ from Atran, consisting of leaves only, which Wallich put under *S. acuminata*.

A sample of the seeds of 'Khabaung' was submitted to Prof. H. G. Greenish, of the Pharmaceutical Society, for analysis, and he reports as follows:—

"I have examined the seeds of *Strychnos* 'Khabaung' with the following result:—As I wished to determine the amount of strychnine and brucine (if any) present in the seeds, I followed the assay process of the British Pharmacopœia. The amount of residue (which would contain the strychnine, brucine or other

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* The seeds of *S. Nux-vomica* from Burma referred to by Dunstan and Short) see Pharm. Journ. xiii. ser. 3, p. 1053), were evidently taken from Griffith's specimen 3722, and therefore belong to *S. Nux-blanda*, A. W. Hill.

† Since the above was written seeds have been sent to the Imperial Institute from Burma as *Nux-vomica*, and were forwarded to Kew for identification.

‡ The other specimens under 1593 referred to *S. acuminata*, Wall, are 1593 (1) = *S. laurina*, Wall.; 1593 (2) = *S. rufa*, var. *Candollei*, C. B. Clarke, a plant of doubtful affinity and possibly not nearly allied to *S. rufa*, C. B. Clarke.

alkaloid soluble in ether-chloroform) was quite negligible and when treated with diluted sulphuric acid and Mayer's reagent added gave no precipitate. The quantity of powdered seed operated upon was 7·5 grammes; this powder was quite free from bitterness.

"I conclude that the seeds contain no strychnine, brucine, or other alkaloid soluble in ether-chloroform; or at least that the quantity of alkaloid must be so very minute that it cannot be detected in the quantity of seed used with the process adopted."

It would appear that the seeds of *S. Nux-blanda* had previously been subjected to analysis, for Mr. J. Small's 'Note on False Nux-vomica Seed' (see Pharm. Journ. xxxvi. ser. iv. April 12, 1913, p. 510), from Burma no doubt refers to this species. He was unable to detect any strychnine in the seed.

The specific name *Nux-blanda* has been given to this new species to indicate both its long confusion with *S. Nux-vomica* and the absence of alkaloids in seeds.

With reference to the var. *hirsuta*, Pierre realised he was dealing with an undescribed species, and gave his plant the MS. name of *S. ranconensis* (on the sheets at Paris), which has never been published. The flowers, fruits and seeds agree very closely with those of *S. Nux-blanda*, but from the hairiness of the nerves of the leaf these S. Indo-Chinese plants can easily be separated as a distinct variety. Dop includes *Spire* 793 from the Prov. Luang Prabang, Laos, under his var. *grandiflora*, but this latter plant is quite glabrous and agrees with the type specimens of *S. Nux-blanda*.

65. **S. ligustrina,** *Blume* in Rumphia, i. p. 68. t. 25; Rumph. Amb. 2. p. 121. t. 38; Mal. Breyn. l.c. 19 t. 5. f. 2.; A. DC. in DC. Prodr. ix. p. 15; A. W. Hill in Kew Bull. 1911. p. 286. *S. Nux-vomica*, Benth. quoad syn. in Journ. Linn. Soc. i. p. 103 non Linn. cf. etiam C. B. Clarke in Hook. f. Flor. Brit. Ind. iv. p. 90 in adnot. *S. Nux-vomicae*. *S. Nux-vomica*, L., β *depauperata*, Miq. Flor. Ned. Ind. ii. p. 378 (?). *S. colubrina*, auct. plur. non Linn. nec Wight nec Van Roy. *S. muricata*, Kostel in Miq. Flor. Ned. Ind. ii. p. 380; DC. Prodr. ix. p. 15.

Timor. Coepang, *R. Brown* (1803) in herb. mus. Brit.; Timor, *Zippel*; Koepang, *Teysmann* 8969; Spanoghe, *Kajve Oclar* (19, 1911. 32) in herb. Mus. Lugd. Bat.

As was pointed out in Kew Bull. 1911, pp. 286, 287, *S. ligustrina* and *S. lucida* appear to be very closely allied, and it may be that we are dealing with only a single species. *S. ligustrina*, Bl., is described as a tree and *S. lucida*, R. Br., as a shrub, but the specimens sent to Kew from the Walsh River, Queensland, appear to be a tree if the wood specimen at the Imperial Institute (see under *S. lucida*) really belongs to the Walsh River specimen.

S. lucida and *S. ligustrina* can scarcely be separated on leaf and floral characters. In their fruits and seeds, etc., they show considerable affinity to *S. Nux-vomica*.

66. **S. lucida,** *R. Br.* Prodr. p. 469; G. Don. Dict. iv. p. 65; A. DC. in DC. Prodr. ix. p. 16; Benth. Flor. Aust. iv. p. 369; Bailey, Queensland Flora, iii. p. 1024; A. W. Hill in Kew Bull. 1911, p. 287.

N. Australia. Port Darwin, *Schultz* 341, 605; Carpentaria Islands, *R. Brown* 2913; Goulbourn Island, *Cunningham;* Victoria River, *F. Mueller;* Roe's River, Regent's River, *Cunningham* 321; Wyndham, *J. Staer* (Sep. 1905) herb. Edin.; Thursday Island, *E. Cowley*; Walsh River, *T. Barclay Millar.*

In Bailey's catalogue of Queensland Woods, specimen no. 285 is said to be the wood of *S. lucida.* A specimen is now preserved at the Imperial Institute and evidently was cut from a small tree. The wood is heavy and very close grained and differs markedly from the wood of no. 286 (*S. psilosperma,* F. Muell.?).

The specimen bears on the label the locality Walsh River, and if this is the tributary of the Mitchell River rising in the hills near Cairns, the locality is so far from the N. Australian home of *S. lucida,* where it is described as a shrub, that it seems possible the wood may belong to an undescribed species of *Strychnos.*

A specimen labelled 'Walsh River,' however, and collected by Mr. T. Barclay Millar in March, 1891, appears to be identical with *S. lucida* and may be the one quoted by Bailey, so the matter is rather uncertain.

67. **S. cinnamomifolia,** *Thwaites,* Enum. Plant. Zeylan. p. 201; descr. emend. et ampl.

Folia ovato- vel elliptico-lanceolata, apice sensim acuminata vel acuta, basi cuneata, rarius rotundato-cuneata, 8-9·5 cm. longa, 3·5-4 cm. lata, triplinervia, venis approximatis. *Inflorescentiae* sublaxae, pedicellis ferrugineo-pubescentibus brevibus. *Calyx* 1·5-2 mm. longus; segmenta late ovata, subacuta vel acuta, minute ferrugineo-pubescentia. *Corolla* 1·4 cm. longa, lobis circiter 4 mm. longis. *Antherae* 1·5-1·75 mm. longae, apiculatae. *Fructus* globoso-ovoideus, 6·5-9 cm. longus, 5-7·8 cm. latus; pericarpium lignosum, 6-7 mm. crassum, laeve, vernicosum. *Semina* 8-15, irregulariter elliptica vel orbiculari-elliptica, 2-3 cm. longa, 1·3-2·4 cm. lata, subcompressa, circiter 1 cm. crassa, subbiconvexa, pilis sericeo-laneis dense vestita, plerumque margine incrassato circumcincta; C. B. Clarke in Hook. f. Flor. Brit. Ind. iv. p. 89 syn. excl.; Trimen, Fl. Ceylon, pt. iii. p. 174.

Ceylon. Hantani District, moist low country; 600-900 m., *Thwaites* 1867; without locality, *Gardner* 578; *Walker*; seeds (Eta-Kiunda-wel) Col. Ind. Exhib. 171, 1886 in Mus. Kew (Eta-Kirindi-wel, *Trimen*); fruits and seeds, *Petch* (recd. 1917).

1102 Var. **Wightii,** *A. W. Hill. Folia* ovata vel late ovata, 6·5-14 cm. longa, 3·5-7·5 cm. lata, plerumque 9-11 cm. longa, 5-6 cm. lata, plus minusve abrupte acuta, basi rotundato-cuneata vel rotundata, triplinervia, venis approximatis. *Inflorescentiae* floribus congestis pedicellis ferrugineo-pubescentibus brevibus crassiusculis. *Calyx* 1·75 mm. longus; segmenta elliptico-ovata, subacuta vel acuta, minute ferrugineo-pubescentia. *Corolla* 1·4 cm. longa, lobis 3-4 mm.

longis. *Antherae* 1·75 mm. longae, apiculatae. *Fructus* 7·5-10 cm. diametro (*Bourdillon* 789 in MS. in Trav. Forest herb.), rotundato-ovoideus, circiter 8 cm. longus, 7·2 cm. latus; pericarpium lignosum, 4 mm. crassum. *Semina* (vix matura?) circiter 15, 2·5-2·8 cm. longa, plus minusve 1·5 cm. lata, ovoidea vel elliptica, compressa, 4 mm. crassa, pilis sericeo-laneis dense vestita, plerumque margine incrassato 1-1·5 mm. lato circumcincta (*Bourdillon* spec. in Mus. Kew, comm. ix. 1896); *S. colubrina*, Roxb. Fl. Ind. ii. p. 264; Fl. Ind. i. p. 577. Wight, Icon. t. 434 non Linn. *S. cinnamomifolia*, Clarke in Hook. f. Flor. Brit. Ind. iv. p. 89 quoad syn. Wight tantum non Thw.; *S. Nux-vomica*, C. B. Clarke l.c., p. 90 quoad syn. *S. lucida*, Wall. 1590 partim. *S. cinnamomifolia*, Brandis, Indian Trees, p. 475 non Thw. spec. Zeylan. excl. *S. Bourdilloni*, Brandis. Indian Trees, p. 474.

S. India. Without locality *Wight* 2286 (*K.D.* 1814); *Herb. Wight* 2286, 2288 partim and 640 (?) in herb. Glasgow. Travancore: Nannattapara; 600 m., *Bourdillon* 75, 789 (evergreen forest, flowers Feb.-April, fruits Oct., gigantic climber); 0-750 m., *Bourdillon* 759; Coorg & S. Canara (enormous creeper) *Beddome* in herb. Madras; Kottur, *Rama Rao* 489; Koni, *Thomas* (1900) herb. Travancore; Nallay Mallys, *Beddome* 5303; S. Canara, *Beddome* 5304 in herb. Mus. Brit.; Cochin, 450 m., *Meebold* 12507; Mysore: Kempkull; 600 m., *Meebold* 8543; Rajampara, *Rama Rao* 91; (Fruits), *Bourdillon* ix. 1896 in Mus. Kew; (Seed), Quilon, *Conservator Forests* in herb. Calc.

Assam. Silhet, *Smith* (Roxb. Fl. Ind. ii. p. 264); without locality, *Roxburgh* (1813) in herb. Mus. Brit.; Khasia: Pundua *De Silva*.—*Wallich Cat.* 1590 in herb. Kew. *Wallich Cat.* 1590 in herb. Edin.; Cachar 17 without collector's name in herb. Edin.

The seeds of the type which have recently been received at Kew through the kind offices of Mr. T. Petch are rather larger and thicker than those from Travancore and are unusually biconvex and about 1 cm. thick. The wall of the fresh fruit is 6-7 mm. thick and the seeds are embedded in a solid fleshy pulp. The seeds show a distinct marginal border and have a dense felt-like covering of short hairs which do not show the satiny lustre of those on the seeds of *S. Nux-vomica*. Prof. Greenish, who has kindly analysed the seeds, informs me that they contain 2·07 per cent. of alkaloid, which is brucine, the percentage of strychnine being very small. The species may be distinguished principally by its leaves, which are markedly cuneate at the base.

The drawing published by Wight in his Icones (t. 434) is a copy of Roxburgh's drawing, the original of which is at Kew. In this coloured figure the fruits are a bright orange. The diameter of the fruit figured is 4 cm. and four seeds are shown, but it is not stated whether the fruit is natural size. Bourdillon's specimens from Travancore have a larger fruit.

The specimens in the Wight herbarium at Glasgow closely resemble the plant drawn by Roxburgh, but unfortunately there is nothing to show on what specimen the drawing was based or whether it came from Silhet or from S.W. India. The Roxburgh

specimens at the British Museum bear no indication of the locality, but are named *S. colubrina* by Roxburgh himself. The specimens agree very well with his description of Smith's Silhet plant in Flor. Ind. ii. p. 264. Wight's specimens no doubt came from the Indian peninsula and they agree exactly with specimens since collected from that region; it would appear, therefore, that he was so satisfied with Roxburgh's drawing, made apparently from a Silhet plant, that he accepted it as being typical of his specimens from the Indian peninsula.

The evidence that *S. cinnamomifolia*, var. *Wightii* occurs in Assam mainly depends on the *De Silva* specimens in the Wallichian Herbarium and also on Roxburgh's statement in the Flora Indica. More definite information is to be desired, but such as it is it receives some support from the parallel case of *S. aenea*, A. W. Hill (see p. 138), which occurs in Travancore and is represented in Silhet and Cachar by a scarcely distinguishable variety. The following particulars about the Wallichian specimens throw some light on their original habitat.

In Wallich's herbarium, under the name *S. lucida* and number 1590, there is a very distinct plant since named by Bentham *S. Wallichiana*. Mounted on this same sheet, however, is the leaf of quite another species which proves to be identical with the entire specimens bearing Wallich's number 1590, preserved at Kew and at Edinburgh.

The specimens according to the label were collected at Pundua by De Silva, who certainly travelled in Silhet and not in S. India, and they agree very well with Roxburgh's drawing of *S. colubrina* (Wight's Icones t. 434).

As a further indication that Silhet is really the habitat of these specimens it is of interest to find that on the Edinburgh sheet of *Wallich* 1590 an inflorescence of *S. Wallichiana* (an undoubted Silhet plant) has been mounted among the leaves. Some correlative evidence is also afforded by the sheet of no. 1590 at the British Museum, which consists of a fragment of *S. Wallichiana*, Benth., and a large branch of *S. aenea*, var. *acuminata*, A. W. Hill (see p. 138).

S. Bourdilloni, Brandis, which is referred here to *S. cinnamomifolia* var. *Wightii*, was described from specimens with flowers in the bud stage and before the corolla tube had developed.

It seems better to refer the Indian specimens of *S. cinnamomifolia* to a variety, since they differ from the Ceylon plant in having broader leaves with more rounded bases and somewhat different seeds.

The resemblance between this species and *S. Nux-vomica* is considerable, but the latter being a tree with different leaves, fruits and seeds, can easily be distinguished from the huge climbing plant.

68. **S. rupicola,** *Pierre* ex Dop in Bull. Soc. Bot. Fr. lvii. Mém. 19 (1910), p. 17, et in Lecomte, Flor. Gen. Ind.-Chin. iv. p. 168.

Indo-China. Cambodia. Prov. Samrong tong; Monts Pra, *Pierre* 3688.

A subscandent species with leaves like those of *S. cinnamomifolia*. The flowers are immature and fruits are unknown.

69. **S. tubiflora,** *A. W. Hill*; species *S. cinnamomifoliae*, Thw., affinis foliis ovatis venis distantibus fructibus seminibusque minoribus praecipue differt.

Folia ovata vel rotundato-ovata, 7-10·5 cm. longa, 4-7·5 cm. lata, abrupte acuminata, basi rotundata, superne vernicosa, trivel subtriplinervia, venis distantibus. *Inflorescentiae* ramulis bifoliatis axillaribus laxae instructae, pedicellis gracilibus glabris. *Calyx* 1 mm. longus; segmenta ovata, acuta, glabra. *Corolla* 1·4 cm. longa, lobis circiter 3 mm. longis, tubo ima basin hirsuto. *Antherae* 2 mm. longae, apiculatae. *Ovarium* cum stylo glabrum. *Fructus* circiter 4 cm. diametro; pericarpium crustaceum, 1·5-1·75 mm. crassum, minute verruculosum. *Semina* ovoidea, compressa, 1·8-2 cm. longa, pilis laneis intertextis vestita.

Andaman Islands. S. Andamans: Dhani Khari; hill jungle (May), *King*; Andamans, (Nov. Fr.) *Prain's Collector* 22, 84, 293.

The Andaman plant has been referred to *S. cinnamomifolia*, Thw., and is no doubt nearly allied to that species. The broadly ovate, trinerved or subtriplinerved leaves with their more distant and less conspicuous veins, the slender glabrous inflorescences and smaller fruits and seeds serve to distinguish the Andaman specimens from those of *S. cinnamomifolia* from Ceylon and Travancore.

70. **S. Pierriana,** *A. W. Hill*; species *S. cinnamomifoliae*, var. *Wightii*, A. W. Hill, et *S. rupicolae*, Pierre, affinis, ab hac foliis ellipticis pericarpio laeve, ab illa foliis trinervis praecipue differt.

Frutex scandens, glaber, ramulis cylindratis. *Folia* elliptica, basi rotundato-cuneata, apice abrupte acuminata vel acuta, 6-9 cm. longa, 3-5 cm. lata, trinervia, venis approximatis. *Inflorescentiae* ramulos axillares foliosos terminantes; pedunculi et pedicelli ferrugineo-pubescentes. *Calyx* 1·25 mm. longus, ciliatus. *Corolla* extra papillosa. 1·1-1·2 cm. longa; lobi 3-5 mm. longi, tubo intus inferne hirsuto. *Antherae* oblongae, apiculatae, 1·5 mm. longae, glabrae, paullo infra faucem insertae. *Ovarium* glabrum, stylo glabro 7 mm. longo. *Bacca* 4 cm. diametro; pericarpium 3 mm. crassum. *Semina* immatura 2·3-2·7 cm. longa, 1·5-1·8 cm. lata, complanata, pilis sericeis obtecta. *S. Gauthierana*, Pierre ex Dop in Bull. Soc. Bot. Fr. lvii. Mém. 19 (1910), p. 17, partim et in Lecomte, Flor. Gén. Indo-Chin. iv. p. 167, partim, Pl. iii. figs. B, 1-5, non Fig. A.

Indo-China. Annam: Prov. Nghê an; Conchank *Gauthier in herb. Pierre* 1663.

The above description is only slightly altered from the MS. description at Paris written by Pierre. It is attached to a flowering specimen, apparently collected by Gauthier, included

with Lesserteur's specimens of the leaves and bark of Hoàng Nàn (see p. 203) which is the true *S. Gautheriana*. Dop also includes *Balansa* 2129 from Tonkin and has modified Pierre's description of *S. Gautheriana* to include the fruits and seeds of that species. The true fruit of Gauthier's plant with immature seeds is in the fruit collection at Paris. He does not appear to have noticed that in the Gauthier plant the inflorescences are borne on leafy shoots as in *Nux-vomica*, while in Balansa's specimen they are small axillary leafless panicles. The inflorescence of Gauthier's plant is correctly depicted in the Flor. Gén. Indo-Chin. iv. Pl. iii. fig. B, but fig. A represents the flowerless branch of *S. Gautheriana*.

Much confusion has been caused since Pierre drew up his description of *S. Gautheriana* both from the flowering plant and from specimens of the true Hoàng Nàn; moreover it would appear that both plants grow together in the same locality.

S. Pierriana shows considerable affinity to *S. cinnamomifolia*, var. *Wightii*, but differs especially in the seeds which have a silky coat and in the trinerved leaves. It is also no doubt closely allied to *S. rupicola*, Pierre, from Cambodia, of which only immature specimens have been collected.

71. **S. Wallichiana,** *Benth.* in Journ. Linn. Soc. i. p. 90; descr. ampl.

Folia elliptica, 12-14 cm. longa, 4-4·5 cm. lata, abrupte et longe acuminata, basi cuneata vel rotundato-cuneata, superne vernicosa, coriacea, 5-nervia, triplinervia, nervis intermediis proxime ad margines dispositis et ad eos subparallelis pagina superiore impressis; venis approximatis, marginibus incurvatis pubescentibus; petioli 0·5-1 cm. longi. *Inflorescentiae* longe pedunculatae, axillares, 6-10 cm. longae, corymbis 2-2·5 cm. longis multifloris, pedunculis pedicellisque pubescentibus. *Calycis* segmenta elliptica, subacuta, glabra vel subglabra, 1-1·25 mm. longa, marginibus ciliatis. *Corolla* 1·2-1·35 mm. longa, lobis 2-2·5 mm. longis reflexis subcucullatis ad basin linea pilorum laneorum dense instructis, tubo glabro. *Antherae* 0·85-1 mm. longae, glabrae, ellipticae, exsertae, filamentis 0·5-0·65 mm. longis. *Ovarium* glabrum; stylus circiter 1 cm. longus, pilis erectis versus basin dense instructus. *S. lucida*, Wall. Cat. 1590 partim* non R. Br.; Steud. ex A. DC. Prodr. ix. p. 13 partim; Clarke in Hook. f. Flor. Brit. Ind. iv. p. 90; Brandis, Indian Trees, p. 475. *S. nitida*, G. Don, Dict. iv. p. 66.

India. Silhet: Pundua, *Wallich* 1590 in herb. Wall. nec in herb. Kew nec herb. Mus. Brit. nec Edin. Assam: Mikio Hills (March), *Simons*; Margerita, Luckinpore, *C. B. Clarke* 37876 A. (sub nom. *Myxopyrum smilacifolium*) in herb. Mus. Brit.; Kufoo Forest, *Griffith K.D.* 3726. Chittagong; Pharoka, *Gamble* 6720 A. in herb. Gamble. Golaghat, *King's Collector*

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* *Wallich* 1590 in herb. Wall. = *S. Wallichana.* In herb. Kew, the specimen bearing this label is *S. cinnamomifolia*, var. *Wightii* (a leaf of this is also attached to the Wallichian sheet), and at the British Museum it is partly *S. Wallichiana*, Benth., and partly *S. aenea*, var. *acuminata*.

(1891); Dibru Ghar, *Masters* 1109; Lushai Hills, Changsil, *Prazer*. Chittagong Hill Tracts, *Gamble* 6720 b.

Var. **ovata,** *A. W. Hill. Folia* late ovata, 8-11 cm. longa, 5-6·3 cm. lata, conspicue 5-nervia, sub-triplinervia, abrupte acuta, basi rotundata vel rotundato-cuneata, petiolis marginibus ut in typo incurvatis pubescentibus. *S. Wallichiana*, Steud. ex Kurz, For. Fl. ii. p. 167; Kurz, Rep. For. Veg. Pegu (1875), append. A. p. xci., B. p. 68; vide Brandis, Indian Trees, p. 474, § 2.

Burma. Pegu: Yomah, *Kurz* 2319.

Var. **intermedia,** *A. W. Hill. Folia* elliptico-ovata vel ovata, 8-11 cm. longa, 4·5-5·5 cm. lata, apice plus minusve abrupte acuta, basi rotundata, 5-nervia, triplinervia, vernicosa, coriacea, nervis vix impressis.

Chittagong. Burkul, *Lister* 321.

S. Wallichiana is a distinct plant, among the species with a long corolla tube, in having a dense line of hairs at the base of the corolla lobes, surrounding the anther filaments, and in having the lower two-thirds of the style covered with erect hairs. The ovary and the corolla tube are glabrous.

In the type specimens the two intermediate nerves run parallel to the margins of the long elliptic leaves and are placed some 5 mm. from the actual margins; the outermost pair of nerves, which are inconspicuous, run just inside the margins. In the variety *ovata* the intermediate nerves retain the elliptic outline seen in the type, but there is a broad extent of leaf lamina between them and the margin owing to the widely ovate shape of the leaf; the lamina is also much thinner. From Chittagong a plant intermediate between the type and the var. *ovata* has been collected, which is sufficiently distinct to be considered a separate variety with the name *intermedia*.

72. **S. Spireana,** *Dop* in Bull. Soc. Bot. Fr. lvii. Mém. 19 (1910), p. 19 et in Lecomte, Flor. Gén. Ind.-Chin. iv. p. 169, Pl. iii. figs. C, 6-10.

Indo-China. Laos: Tranninh; Cahn-Trap, *Spire* 1204.

According to Dop this species is distinct in having the lobes of the corolla hairy on the inside, a character however which I have failed to recognise. The leaves closely resemble those of *S. Pierriana*, but the inflorescences appear to be less pubescent. Fruits are unknown. It is very doubtful whether this is a good species.

73. **S. cuspidata,** *A. W. Hill*, in Kew Bull. 1909, p. 359; et in Kew Bull. 1911, p. 288.

Malay Archipelago. Borneo: Sarawak; Kuteing, *Beccari* 1188, 1348; Borneo Central: Ipoe Kajo, *Nieuwenhuis* in herb. Hort. Bot. Reg. (?)

The Central Borneo specimen is said to be a tall tree, as it consists of leaves only; its reference to this species must be

regarded as doubtful. Mature fruits of *S. cuspidata* are unknown. The ovary and style are glabrous.

74. **S. Balansae,** *A. W. Hill*; species *S. ovalifolia*, Wall., affinis, foliis ovatis majoribus inflorescentiis majoribus dense ferrugineo-pubescentibus seminis grandibus numerosis pilis laneis hebetibus obtectis praecipue differt.

Frutex scandens, glaber. *Folia* ovata vel ovato-elliptica, plus minusve abrupte acuminata, basi rotundata, 8-13 cm. longa, 4-6 cm. lata, glabra, vernicosa, trinervia, 3-5-nervia, venis approximatis conspicuis; petioli circiter 1 cm. longi. *Inflorescentiae* axillares, paniculatae, 2-2·5 cm. longae, pedunculis pedicellisque dense ferrugineo-pubescentibus. Calycis *segmenta* triangulari-ovata, subacuta, pubescentia. *Corolla* 1·1·3 cm. longa, lobis 5-6 mm. longis glabris, tubo interiore subtus hirsuto. *Antherae* oblongae, 2 mm. longae. *Ovarium* glabrum, cum stylo glabro 1·2 cm. longum. *Bacca* globosa; pericarpium crustaceum, laeve, circiter 1 mm. crassum. *Semina* numerosa, irregulariter elliptica, 2-2·6 cm. longa, 1·7 cm. lata, complanata, plus minusve 6-7 mm. crassa, pilis laneis hebetibus obtecta. *S. Gauthierana*, Dop in Bull. Soc. Bot. Fr. lv. ii. Mém. 19 (1910), p. 17, et in Lecomte, Flor. Gén. Ind.-Chin. pt. v. p. 167, partim. *S. Gautheriana*, A. W. Hill in Kew Bull. 1911. p. 289, partim.

Indo-China. Tonkin: Prov. Tung Tien; Vallée de Lankok (Mont Bavi); forests, *Balansa* 2129.

This species resembles *S. ovalifolia*, Wall., but is easily distinguished by its larger leaves and by the thin-walled fruits with large seeds. As all the fruits at Paris are broken neither their size nor the number of the seeds can be given.

75. **S. Ignatii,** *Berg.* Mat. Med. i. p. 146 (1778); G. Don, Dict. iv. p. 65; Oliver in Hook. Icon. t. 2212; Tavera in Med. Pl. Philipp. Is. (trans. Thomas), 1901, pp. 171-173; De Lanessan, Pl. Utiles des Colon. Franc. Flor. Cochin. 1886, p. 767; Watt, Dict. Econ. Prod. Ind. vi. pt. iii. p. 379 A. W. Hill in Kew Bull. 1911, p. 290. *Strychnos philippensis*, Blanco, Flor. Filip. ed. 2 (1845), p. 61.

Philippine Islands. Mindanao: Boxall in herb. Kew.; Lake Lanao, *Clemens* 895; Central Mindanao, *Lyon.*

Leyte: near Dagami; woody vine in forests, *Ramos Bur. Sc. No.* 15286;

Samar: Catbalogan, *Carruthers; Guerrero; Cullen* (seedlings) *Bur. Sc. No.* 10835.

Biliran: Lowland forest, *McGregor Bur. Sc. No.* 18713.

Easily distinguished from all other species by the large fruits and irregularly trigonous stony seeds. For further particulars see *K.B.* 1911, p. 290.

76. **S. Tieuté,** *Lesch.* in Ann. Mus. Hist. Nat. xvi. p. 479, t. 23; Blume in Rumphia, i. p. 67, t. 24; G. Don, Dict. iv. p. 66; A. DC. in DC. Prodr. ix. p. 13; Miq. Flor. Ned. Ind. ii. p. 380; Benth. in Journ. Linn. Soc. i. (1857) p. 103; King & Gamble in Mat. Flor. Mal. Penins. iv. p. 831 partim; non Dop in

Bull. Soc. Bot. Fr. lvii. Mém. 19 (1910), p. 16; A. W. Hill in Kew Bull. 1911, p. 292.

Malay Archipelago. Java: *Teysmann; Hallier; Reinwardt* 1599; *Zollinger* 2635; *Horsfield* 368; *Pulle; Kurz.*

In foliage and floral character *S. Tieuté* closely resembles *S. ovalifolia*, Wall., from the Malay Peninsula; the most useful distinguishing character lies in the plano-convex seeds with their thick covering of closely felted hairs. In *S. ovalifolia* the seeds have a satiny coat. The original description and figure given by Leschenault is of a leafy specimen only. The triplinerved leaves are well drawn, and it is therefore not so surprising that Colebrooke should have suggested that his *S. axillaris* (see Trans. Linn. Soc. xii. p. 357) might be compared with *S. Tieuté.*

77. **S. ovalifolia,** *Wall.* Cat. 1592; A. DC. in DC. Prodr. ix. p. 13; G. Don, Dict. iv. p. 65; Benth. in Journ. Linn. Soc. i. p. 103; Miq. Flor. Ned. Ind. ii. p. 380; King & Gamble, Mat. Flor. Mal. Penins. iv. p. 826 partim (*Curtis* 3044 et *King's Coll.* 4865 excl.). *S. laurina*, C. B. Clarke in Hook. f. Flor. Brit. Ind. iv. p. 88 (quoad *S. ovatifolia*! *Wall. Cat.* 1592). *S. pseudo-tieuté*, A. W. Hill in Kew Bull. 1911, p. 287. *S. Tieuté*, King & Gamble in Mat. Flor. Mal. Penins. iv. p. 831 partim, non Lesch. in Ann. Mus. Hist. Nat. xvi. p. 479, t. 23; P. Dop in Mem. 19, Bull. Soc. Bot. Fr. lvii. p. 16. quoad *S. Maingayi* var.? *fructuosa*, C. B. Clarke et *Beccari* 1580. *S. Beccarii*, Gilg in Notizbl. der Kgl. Bot. Gart. Berlin, no. 8 (1897) p. 267; A. W. Hill in Kew Bull. 1911, p. 291.

The following emendation to the description in *Kew Bull.* 1911, p. 287 (*S. pseudo-tieuté*) is necessary.

Folia 5·5-12 cm. longa, 2·8-6·5 cm, lata. *Inflorescentiae* usque ad 3 cm. longae, pedunculis 0·5-2 cm. longis glabris vel subglabris, pedicellis ferrugineo-pubescentibus. *Corollae* tubus intus versus basin pilis paucis instructus. *Antherae* apiculatae. *Semina* pilis sericeis nitentibus dense vestita.

Malay Peninsula. Perak: Larut; 450-610 m. (open jungle clinging to trees) *King's Collector* 5348; *King's Collector* 10595 (large creeper 18-30 m. long).

Penang: *Wallich* 1592 in herb. Wall.; Government Hill 30-60 m., *Curtis* 3468; 300 m. *Curtis* 709*; Experiment nursery 600 m. *Curtis* 1490 (a climber); Government Hill, *Maingay* 2286 (*K.D.* 1038). Penang Hill, *Ridley* 9358; Moniots Road *Ridley.*

Malacca: *Maingay* 3289 (*K.D.* 1037); Bukit Sidanan Reserve, *Corporal Hasan* (*local name* Ipoh Akar Buah Kechil); Sungei Udang Reserve, *Corporal Ali* (*local name* Ipoh Akar).

Singapore: Garden Jungle, *Ridley;* without locality, *Cantley* 176 in herb. Kew; *Ridley* 2746, 5645 A in herb. Mus. Brit.

Malay Archipelago. Borneo: Sarawak, *Beccari* 1580; 3767; Amai Ambit, Maudai River, *Hallier* 3153 B. (?)

Bentham suggests that Wallich's *S. ovalifolia* is allied

* In *Kew Bull.*, 1911, p. 287, this number was wrongly cited as *Curtis* 700.

to *S. Wallichiana* but the character of the leaves, calyx and style do not suggest that this is a real affinity. I can find no real difference between *Wallich* 1592 and the various plants referred to *S. pseudo-tieuté*, A. W. Hill, and have therefore included this species as a synonym of *S. ovalifolia*. The condition of the Wallichian specimens is unfortunately imperfect, neither whole flowers nor fruit being present, but the only differences between the two species are the long, lax inflorescences and the rather larger leaves of Wallich's plant. In all the specimens previously placed under *S. pseudo-tieuté* the main peduncle is stout and does not exceed 1 cm. in length, the inflorescence being a compact panicle. In Wallich's plant the inflorescence is a lax corymb, borne on a long slender peduncle which may be due to conditions of dense shade. In all cases however the main peduncle is glabrous or subglabrous the pedicels and calyces being ferrugineous-pubescent.

Under *S. ovalifolia*, King and Gamble include *King's Coll.* 4865 and *Curtis* 3044, but I have referred both of these to my new species *S. quintuplinervis*. Their description of the fruit and seed of *S. ovalifolia* therefore, which was drawn up from *King's Collector* 4865, applies to *S. quintuplinervis*, and not to *S. ovalifolia* (see p. 166).

The fruit of *S. ovalifolia* is correctly described under *S. pseudo-tieuté*, A. W. Hill in *K.B.* 1911, p. 287, and is remarkable for its thick woody pericarp.

I can also find no essential difference between *S. ovalifolia*, from the Malay Peninsula and *S. Beccarii*, Gilg, from Borneo and have therefore merged the latter species in *S. ovalifolia*. The seeds with their satiny coat distinguish this species easily from *S. Tieuté* from Java in which the seeds are covered with a thick woolly felt.

Bentham* suggests that Wallich's *S. acuminata* from Amherst should be referred to *S. ovalifolia*. It is a leaf specimen only and is here considered to belong to *S. laurina*.

Species non satis notae.

78. *S. rufa*, C. B. Clarke.
79. *S. narcondamensis*, A. W. Hill.
80. *S. Gautheriana*, Pierre.
81. *S. quadrangularis*, A. W. Hill.
82. *S. tesseroidea*, A. W. Hill.
83. *S. monosperma*, Miq.
84. *S. myrioneura*, Gilg.
85. *S. Thorelii*, Pierre.
86. *S. polyantha*, Pierre.
87. *S. donnaiensis*, Pierre.
88. *S. usitata*, Pierre.
89. *S. dinhensis*, Pierre.
90. *S. leuconeura*, Gilg et Benedict.
91. *S. Kerstingii*, Gilg et K. Schum.
92. *S. Bancroftiana*, Bailey.

* Journ. Linn. Soc. i, p. 103.

78. **S. rufa,** *C. B. Clarke* in Hook. f. Fl. Brit. Ind. iv. p. 89; non King & Gamble, Mat. Fl. Mal. Penins. iv. p. 827.

Malay Peninsula. Malacca: *Maingay* (*K.D.* 1034).

Var. **Candollei,** *Clarke.*

Burma. Tenasserim: Amherst, *Wallich* 1593 partim.

Both are leaf specimens only, and it is very doubtful whether the Wallich specimen from Amherst is in any way related to the type plant from Malacca. The other plants placed under this name by King & Gamble, are certainly distinct and have been described under the name *S. Scortechinii*, A. W. Hill (see p. 168).

The leaves in Maingay's plant, on which Clarke founded the species, are thickly covered with scabrid pustules which are prominent on the under surface. The fruit of this same specimen is about 4 cm. in diameter, with a pericarp about 3 mm. in thickness, and contains numerous flattened seeds some 2 cm. long.

There are three doubtful leaf specimens at Calcutta, *Meebold* 15450 from Wagon, Tenasserim; a *Kurz* specimen from Tenasserim, and one collected by *Falconer* in Moulmein, all rufous-tomentose, which may be related to Clarke's doubtful plant *S. rufa*, var. *Candollei* from Amherst; they also show some resemblance to the plant from Narcondam.

79. **S. narcondamensis,** *A. W. Hill.*

Frutex scandens, ramis striatis in juventute rufo-pubescentibus. *Folia* ovato-lanceolata, circiter 9-16·5 cm. longa, 4-6·5 cm. lata, basi rotundata, apice sensim et longe acuminata, superne vernicosa, trinervia, nervis paginae superioris paullo eminentibus, paginae inferioris dense rufo-pubescentibus; petiolis brevibus dense rufo-tomentosis. *S. acuminata*, Prain in Journ. Asiatic Soc. Bengal, lxii. pt. ii. 1893, p. 73, non Wall.

Andamans. Narcondam (March, 1891) *Prain.*

80. **S. Gautheriana,*** *Pierre* MSS. ex Hook. f. Kew Report, 1877, p. 31 (nomen); Lesserteur, Le Hoàng Nàn (1879), p. 2, (descr. imperf.). *S. Gautheriana*, Pierre ex De Lanessan, Les Plantes Utiles des Colonies Français, Flor. Cochin. (1886), p. 767; ex Dop in Bull. Soc. Bot. Fr. lvii. Mém. 19, p. 17 partim et in Lecomte, Flor. Gén. Ind.-Chin. iv. p. 167 partim, Pl. iii. Fig. A tantum; A. W. Hill in Kew Bull. 1911, p. 289, quoad *Lesserteur H.P.* 1663 tantum. *S. malaccensis*, C. B. Clarke quoad syn. in Hook. f. Flor. Brit. Ind. iv. p. 89, et King & Gamble, Mat. Flor. Mal. Penins. iv. p. 829, non Benth.

Frutex scandens; rami crassi, cortice rugoso sub cuticula cinerea aurantiaco; ramuli plus minusve quadrangulares, glabri; cirrhi bijugi, incrassati. *Folia* elliptica, versus basin et ad apicem plus minusve cuneata, apice longe acuminata, 7·5-13 cm. longa, 4-5·5 cm. lata, trinervia, venis approximatis, glabra, in siccitate rufescentia. *Flores* et fructus ignoti.

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* *S. Gaultheriana* in Ind. Kew. in err.

INDO-CHINA. Annam: Prov. Nghê an; Conchank (Lat. 19°, Long. 105°), and Thanh-hoa, *Lesserteur in herb. Pierre* 1663 in herb. Mus. Paris.

Vern. name. Hoàng Nàn.

One of the earliest references to *S. Gautheriana* (Hoàng Nàn) appears to have been in "Les Missions Catholiques" for 1875, and the following extract is taken from the *Kew Report* for 1877, p. 31:—

"*Hoàng Nàn, a supposed remedy for leprosy.*—Mr. Prestoe, Superintendent of the Trinidad Botanic Garden, has drawn my attention to some accounts given in 'Les Missions Catholiques' for 1875, describing the surprising efficacy of a drug the produce of a plant found in Cochin-China in the treatment of leprosy and rabies. The plant is known by the name of Hoàng Nàn, and the description, which is of the vaguest kind, represents it as a climber, and its bark as the efficacious portion.

"M. L. Pierre, the Director of the Botanic Garden at Saigon, has obtained an imperfect specimen of the Hoàng Nàn, and informs me that he identifies it as a new species of *Strychnos*, which he has named *S. Gautheriana*, in honour of the ecclesiastic who first gave the virtues of the Hoàng Nàn a wider publicity."*

On receipt of this information Sir Joseph Hooker appears to have written for specimens to M. Pierre, for on June 25, 1877, M. Pierre wrote to Kew as follows:—

"J'ai le regret de ne pouvoir vous envoyer des echantillons du *Strychnos Gautheriana* de seul que je posséde, tout à fait incomplet, est celui qui à servi a faire le dessin que je vous envoie.

"Cette espèce doit être considéreé sans valeur jusqu' au moment ou je pourrai en faire une description avec les caractères plus positifs que ceux fournis par les feuilles. Celles-ci me paraissent être voisines du *S. colubrina*, mais en différer par la nervation et par les vrilles."

In the Paris herbarium there are several leafy specimens of Hoàng Nàn bearing the Herb. Pierre number 1663, and with them are pieces of bark, orange-coloured below the surface. This is undoubtedly the medicinal bark whose properties are described by M. Lesserteur in "Le Hoàng Nàn," published in Paris in 1879.

It is in this publication that the first but incomplete description of *S. Gautheriana* is given, which was drawn up by M. Monrouzies, a missionary of Tonkin.

The orange bark, more or less quadrangular branches and sharply acuminate rufescent leaves of this plant are very characteristic. Mixed with these specimens at Paris, however, are two other distinct species. The one collected by *Balansa* in Tonkin has small axillary inflorescences and large irregularly oval seeds, and proves to be a new species allied to *S. ovalifolia*,

* A drawing showing the leaves, twigs and tendrils of Hoàng Nàn was received at Kew from M. Pierre in March, 1878, and it was on this drawing that C. B. Clarke made *S. Gautheriana* the synonym of *S. malaccensis* (see p. 177).

Wall. The other bears the number *Pierre* 1663, but has quite different leaves from those of Hoàng Nàn, and its leafy inflorescences are like those of *S. Nux-vomica* (see Dop in Lecomte, Flor. Gén. Ind.-Chin. iv. Pl. iii. Figs. B and 1-5). This it has been necessary to describe as a new species with the name *S. Pierriana*, A. W. Hill (see p. 197).

The confusion between these two distinct species bearing the number 1663 was the more difficult to unravel, since Pierre himself considered them to be the same plant and there is a MSS. description of the flowering specimen drawn up by him in the Paris herbarium which I have used with very little alteration for *S. Pierriana.*

Both *S. Gautheriana* and *S. Pierriana*, it appears, are found in the calcareous mountains of N. Annam, not far from the locality of the doubtful species *S. Spireana* (see p. 199).

S. Gautheriana shows considerable resemblance to some incomplete specimens collected in the Khasia Hills (also a limestone range) which have been referred to *S. aenea*, var. *acuminata*, A. W. Hill, and it also appears to be allied to *S. Vanprukii*, Craib, from Siam, *S. aenea*, A. W. Hill, from Travancore, and to *S. quadrangularis*, A. W. Hill. A further point of interest in this connection is that *S. Pierriana*, which has been collected and confused with *S. Gautheriana*, appears to be closely allied to *S. cinnamomifolia*, var. *Wightii*, which occurs in the Khasia Hills with *S. aenea*, var. *acuminata* and in S. India grows in the same places as *S. aenea* (see p. 138).

The economic properties of Hoàng Nàn are thoroughly discussed by Lesserteur. De Lanessan* also states that its bark is of a reddish-ochre colour, containing Strychine and Brucine, and is used for leprosy and skin diseases. Shoemaker† too directs attention to the use of Hoàng Nàn in skin diseases, but cannot concur in all the eulogies that have been bestowed on this bark.

81. **S. quadrangularis,** *A. W. Hill*; species ramis quadrangularibus angulis carinatis foliis ellipticis grandis distincta.

Frutex scandens, 15-22 m. longus, robustus; caules 5-6·5 cm. diametro; rami et ramuli glabri, fortiter quadrangulares, angulis carinatis. *Folia* 13-20 cm. longa, 5·5-11 cm. lata elliptica, basi rotundato-cuneata vel in foliis grandibus rotundata, in foliis parvis cuneata, apice plus minusve cuneata, abrupte et longe acuminata, glabra, pagina superiore in sicco hebetia, inferiore aenea, 5-nervia, trinervia, nervis paginae superioris impressis venis primariis approximatis cum reticulationibus conspicuis; petioli circiter 5 mm. longi. *Inflorescentiae* axillares, 4-6 cm. longae (?), pedunculis quadrangularibus minutissime pubescentibus. *Calycis* segmenta triangular-ovata, acuta, glabra marginibus ciliatis exceptis. *Corolla* ignota. *Ovarium* cum stylo glabrum. *Fructus* globosus, circiter 2 cm. diametro, monospermus; pericarpium tenue, crustaceum, verni-

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* Les Plantes Utiles des Colonies Français, Flor. Cochin. 1886, p. 767.

† Shoemaker, Medical Bulletin, November, 1889, p. 348; see also Pharm. Journ. 3. xx. 1889, p. 425.

cosum (in vivo glaucum, *King's Collector*). *Semen* orbiculare, plano-convexum, hemisphericum, circiter 1 cm. diametro, 8 mm. crassum, corneum, glabrum.

Malay Peninsula. Perak: Dense jungle, clinging to large trees, limestone hills, 90-120 m., *King's Collector* 7193 (or (?) 8193); Cheroh, 60 m., *Wray* 4277; Gunong Batu Puteh, 900-1200 m., *Wray* 3, 1236; Perak, *Scortechini* 295 a.

Vernac. name. Ipoh Aker (*Wray*).

A striking plant with its large elliptic leaves, copper-coloured below when dried, and sharply quadrangular stems with conspicuously keeled angles (cf. *S. aenea*, A. W. Hill, p. 138). King & Gamble (Mat. Flor. Mal. Penins. iv. p. 826) refer to these specimens in a note under *S. laurina*, but they differ from that species not only in the characters of stems and leaves but also in the calyx and the glabrous ovary. Wray mentions that the bark of the root is used as an arrow poison by the Sakais.

According to the labels on specimens of *S. ovalifolia*, Wall., collected by Corporals Ali and Hasan in Malacca, they also bear the name 'Ipoh Akar' (see p. 201).

82. **S. tesseroidea,** *A. W. Hill*; species *S. Wenzelii*, Merrill, confusa, foliis trinervis, nervis paginae inferioris pubescentibus semineque differt.

Frutex scandens, ramis in juventute pubescentibus. *Folia* late elliptica, apice sensim acuta, basi rotundato-cuneata vel cuneata, 8-13 cm. longa, 4·2-5·8 cm. lata, superne vernicosa, glabra, nervis impressis inferne fusco-hebetia, nervis striguloso-pubescentibus exceptis glabra, 5-nervia, trinervia, venis inconspicuis, petiolis et cirrhis simplicibus parce pubescentibus. *Inflorescentiae* axillares. *Flores* ignoti. *Bacca* circiter 1·3 cm. diametro, ovoidea, monosperma; pericarpium tenue, crustaceum. *Semina* tesseroidea, 9 mm. longa, 4 mm. lata, cornea, glabra. *S. Wenzelii*, Merrill in Philip. Journ. Sc. xi. No. 4. C. 1916, p. 202, partim, quoad *Ramos* 24381.

Philippine Islands. Samar: Catubig River; 80 m. (Feb. Mar.), *Ramos Bur. Sc. no.* 24381.

The plant when dry assumes a dark brown colour like *S. Wenzelii*, Merrill, but the under surface of the leaf is dull and not shining as in that species. Other differences are put forward in the note under *S. Wenzelii* (see p. 178).

There are two other distinct but imperfectly known species from the Philippine Islands which deserve brief notice, but cannot be described owing to lack of adequate material.

(1) *Strychnos* sp.

Philippine Islands. Ticao: Batuan; on the beach, *W. W. Clark* 1061.

Luzon: Prov. Albay; Castilla, *Vidal* 3936.

The leaves are ovate, acute, trinerved, and rounded at the base. The fruits small, globose, orange in colour, and the seeds circular, flattened, and about 1 cm. in diameter.

(2) *Strychnos* sp.

Luzon: Prov. Batuan; Lamao River (Sept.), *Whitford* 24037.

The leaves are ovate, acute, trinerved, and rounded at the base. Inflorescences paniculate, slender. Ovary crowned with hairs. The fruit and seeds resemble those of *S. multiflora*, Benth., but in general appearance the plant is like those mentioned above and is evidently distinct from *S. multiflora*.

83. **S. monosperma,** *Miq.* Flor. Ned. Ind. ii. p. 381; A. W. Hill in Kew Bull. 1911, pp. 294, 302.

Java.

No specimens have been seen; it is possible that it is closely allied to *S. Horsfieldiana*.

The six following species are natives of Siam or French Indo-China; reference is then made to two imperfectly known species from New Guinea and one from Queensland and a brief note is given as to an undescribed plant from Formosa.

84. **S. myrioneura,** *Gilg* in Flora of Koh Chang (Bot. Tidssk. xxxii. April, 1916), pt. x. p. 388 (312).

Siam. Lem Dan, *Schmidt* 411.

The specimen consists of leaves only—glabrous and triplinerved—and its affinity is quite uncertain.

85. **S. Thorelii,** *Pierre ex Dop* in Bull. Soc. Bot. Fr. lvii. Mém. 19 (1910), p. 20, et in Lecomte, Flor. Gén. Ind.-Chin. iv. p. 171, Pl. iii. figs. 11-13.

Indo-China. Cochin-China: Dinh Mts. *Pierre* 72.

The leaves are subtriplinerved or trinerved and the under-surfaces, nerves especially, are densely rufous-tomentose as are also the stems, petioles and tendrils. Flowers are not known. The thin-shelled fruit with its single seed is figured.

86. **S. polyantha,** *Pierre ex Dop* in Bull. Soc. Bot. Fr. lvii. Mém. 19 (1910), p. 15, et in Lecomte, Flor. Gén. Ind.-Chin. iv. p. 164.

Indo-China. Cochin-China: Dinh, *Pierre* 1721.

The leaves are trinerved with a varnished upper surface. The small axillary inflorescences are unfortunately only in young bud so that it is not possible to assign the species to its proper position. Fruits are also unknown.

Pierre describes *S. polyantha* as a tree 2-4 m. high and suggests that it is allied to *S. paniculata*, Champ. The flowers of the latter species, however, are tetramerous.

87. **S. donnaiensis,** *Pierre ex Dop* in Bull. Soc. Bot. Fr. lvii. Mém. 19 (1910), p. 20, et in Lecomte, Flor. Gén. Ind.-Chin. iv. p. 171.

Indo-China. Cochin-China: Choben, *Pierre* 3692.

The inflorescences are borne on leafy axillary shoots and the seeds resemble those of *S. Nux-vomica*.

88. **S. usitata,** *Pierre* and 89. **S. dinhensis,** *Pierre*, are also from Indo-China and are referred to by Dop l.c.

S. usitata is a very distinct species, the inflorescences are apparently borne on leafy axillary shoots and the seeds are similar in shape to those of *S. Nux-vomica* but are only slightly hairy with a rufous tomentum.

90. **S. leuconeura,** *Gilg et Benedict* in Engl. Bot. Jahrb. liv. p. 169.

New Guinea. Kaiser-Wilhelmsland: Hauptlager Malu am Sepik, 20-40 m., *Ledermann* 7133—(Fr. Apr.).

91. **S. Kerstingii,** *Gilg et K. Schum.* in Fl. Deutsch. Schutzgeb. in der Südsee (1901) p. 498; A. W. Hill in Kew Bull. 1911, p. 302; Engl. Jahrb. liv. heft iii. (1916) p. 164.

New Guinea. Kaiser-Wilhelmsland: *Kersting* 2401.

92. **S. Bancroftiana,** *F. M. Bailey* in Rep. Exped. Bellenden-Ker (1889), p. 49; Synop. Queensl. Fl. Suppl. iii. (1890) p. 47; Queensland Flora, iii. p. 1025. Pl. xliii.; A. W. Hill in Kew Bull. 1911. p. 301.

Queensland. Tringilburra Creek and Mulgrave River, *Bellenden-Ker Exped.* (1889).

The leaves are triplinerved, and not trinerved as shown in the plate. The veins are conspicuously reticulate.

Strychnos sp.

Formosa. Bankinsing Mts., *A. Henry* 1662.

This is evidently a distinct and undescribed species. The young stems and leaf petioles are pubescent as are also the nerves on the under sides of the leaves. The hairs in the latter case being relatively long and scattered. The leaves are narrowly elliptic lanceolate more or less cuneate at the base and subtriplinerved.

The fruits are about 3 cm. in diameter with a thin crustaceous pericarp.

Species Excludenda.

S. Rheedii, *Clarke* in Hook. f. Flor. Brit. India, iv. p. 87; *Modira-Caniram*, Rheede, Hort. Malab. viii. t. 24. *S. colubrina*, Dennstedt, Schlüz. Hort. Malab. (1818) p. 13.

This species was founded by Clarke on the description and figure given by Rheede and he did not assign any specimens to it. As Rheede's figure appears to be a mixture of the flowers and leaves of one species of *Strychnos* with the fruits and seeds of *S. Nux-vomica* it has seemed best to place *S. Rheedii* among excluded species as it is not possible to discover what his flowering plant may have been.

There are two large-fruited species of *Strychnos* known from S. India; the tree *S. Nux-vomica*, and the climber *S. cinnamomifolia*, var. *Wightii*, A. W. Hill. Both species have long-tubed flowers whereas the one figured by Rheede appears to have flowers with a short corolla tube. Rheede's figure of *Modira-Caniram* has been cited by Roxburgh (Fl. Ind. ii. p. 264) under his *S. colubrina* which has evidently a long-tubed flower.

Brandis in "Indian Trees" p. 474 assigns some recent specimens collected by Bourdillon, with a very short corolla tube to Clarke's *S. Rheedii*. Owing to the uncertainty as to Rheede's figure it has seemed best to describe these specimens as a new species under the name *S. aenea* (see p. 138), especially as no fruits have been collected.

With regard to the *Nux-vomica* fruits and seeds of *S. Rheedii*, Burmann, in his note to Rheede's *Modirà-Caniram**, says that the seeds both of the tree *Caniram* (vol. i. t. 37 = *S. Nux-vomica*) and of the 'herb' *Modira-Caniram* (vol. viii. t. 24 = *S. Rheedii*) are the true *Nux-vomica* of pharmacists.

The fruits of the plant figured in Hort. Malab. i. t. 37, are rather oval, and eight seeds are shown in the cross section of the fruit, but none of them are drawn separately. The fruits of the Travancore variety of *S. cinnamomifolia* are inclined to be ovoid so that the ones in this figure may belong to *S. cinnamomifolia* var. *Wightii* rather than to *S. Nux-vomica*, which species the plate otherwise certainly represents.

That the somewhat similar seeds of these two S. W. Indian species have been inter-mixed is also shown by a sample of seeds (No. 412) in the Sloane Collection in the British Museum, which consists of a mixture of the seeds of true *Nux-vomica* and

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* The following is a translation of Rheede Hort. Malab. viii. p. 47, relating to *Modira Caniram*, tab. xxiv, including Burmann's note:—

MODIRA-CANIRAM: *Pao de Solor* or *Pao da Cobra* of the Portuguese: agrees in almost every character with the *Caniram* described already, except that *Caniram* is a tree, *Modira-Caniram* is a herb, the fruit of which has a hard greenish-tawny shell, darkening when ripe to a nut-brown, with a whitish pulp inside, whereas the fruits of *Caniram* when ripe assume a cinnabar red tinge. It gets the name *Modira* from its likeness to the beard on the upper lip [mystax], for *Modira* means moustache*. Its native habitat is about *Mangalti*, *Paroe* and other places, it flowers or fruits almost all the year round. The leaves, boiled with ginger and milk to the consistency of an ointment, drive away gout, which the Malabari term *Vilonda*; a bath made with the leaves has the same effect.

How much trouble and how many conjectures this herb has given rise to among the learned may be gathered from C. Bauhin and J. Bauhin, for this *Caniram* is a second species of that genus. The seed which is contained in the fruits of these two species is the true *Nux Vomica* of pharmacies; the first has been described under trees, and our author is the first who has prepared a true drawing and given us a true description of the plant. These seeds are quite well known in drug-stores, there indeed they are termed Vomit Nuts, Dutch Kraan-oog; the wood is the genuine *lignum colubrinum*. . . . .

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* Sir David Prain, to whom I am indebted for this translation, suggests that the name *Modira* [mystax] may have been applied to this plant because of its tendrils, which, as shown in Rheede plate, are not unlike a curled moustache.

apparently of *S. cinnamomifolia* var. *Wightii*.* These were sent to Sloane by Mr. Cunningham and bear the label "*Nux-vomica offic.*"

Specimina Excludenda.

Strychnos (?) *grandis*, Wall. Cat. 4454; A. DC. in DC. Prodr. ix. p. 17.

Penang, *G. Porter*.

This proves to be **Anisophyllea Gaudichaudiana**, *Baillar*.

Strychnos (?) no. 7500 in Wall. Cat. is of doubtful affinity but is not a member of the family *Loganiaceae*.

XX.—MISCELLANEOUS NOTES.

Munro Briggs Scott.—A particularly sad aspect of the Great War arises from the many losses of young men for whom could easily be prevised useful or even brilliant careers in the world of science. Amongst the names of these already inscribed on the Roll of Honour is that of Munro Briggs Scott, who, to our great sorrow, fell during the advance in the neighbourhood of Arras, in Easter week. Though appointed to the Kew Herbarium less than three years ago the short time he spent there was sufficient to prove that the appointment was a fortunate one for the establishment, where he quickly revealed that capacity and those traits of character that marked him out for a successful future, and those qualities of heart and mind that caused him to be greatly valued as a friend. M. B. Scott, whose home was at East Wemyss, Fifeshire, was born on April 29, 1889. Eventually becoming a student in the University of Edinburgh, from which he received the degrees of M.A. and B.Sc., he studied botany under Professor Bayley Balfour. For some time he was engaged as a teacher in a Scotch school, but preferring botanical work he competed for and won a post at Kew, and commenced his duties as an Assistant in the Herbarium on August 1, 1914. Having attested for the Army he joined the East Surrey Regiment in February, 1916, was transferred to the Suffolk Regiment, created Lance-Corporal, and recommended for a commission. This he obtained in November, distinguishing himself in the examination, and was gazetted to the Royal Scots. About the same time he was married to Miss Flora M'Donald Forbes, M.A., of Pitlochry, Perthshire, and on January 9 last joined the British Expeditionary Force in France. During an attack on April 12 he was wounded, and, while his wound was being dressed, was instantaneously killed by a high-explosive shell. Thus has ended a life of so much promise. Scott's published work consists of several diagnoses of new species which have appeared in the *Kew Bulletin*, 1914 and 1915, an article on *Diospyros Ebenaster*, Retz., contributed to the same journal (1915, pp. 65-66), and a description for the *Botanical Magazine* (t. 8653). A

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* As to the alkaloid content of the seeds of *S. cinnamomifolia*, see under that species p. 195.

revision of the campanulaceous genus *Lightfootia*, which he undertook in his spare time, remains unfinished. Industrious and painstaking, possessed of more than ordinary ability, Scott, had his valuable life been spared, would have taken an important part in the best work of Kew. It has sustained a serious loss by his untimely death.

Philippe Levêque de Vilmorin.—By the death at the early age of 45 of M. Philippe de Vilmorin, Kew has lost a sincere friend and valued correspondent. Head of the firm of Vilmorin, Andrieux & Cie, the deceased had established for himself the reputation of a successful student of practical genetics. In his outdoor collections at Verrières he had also brought together a rich assemblage of living plants; at Dompierre-les-Ormes he had, besides, established an important arboretum which already includes some 900 species.

Shortly after the commencement of hostilities de Vilmorin, who in 1913 had become a member of the Académie d'Agriculture, was attached by the Government of France to their Embassy in London as Secrétaire-général de la Commission d'achats du Ministère de la Guerre. Into his new duties he threw the whole of his remarkable energy. In the course of his work he contracted influenza, followed by pneumonia, which so affected his general health that he had to be invalided to Antibes where, during his convalescence, he returned to his genetic work. After a time his health improved sufficiently to admit of his return to Verrières and his resumption of public duties. Here, unfortunately, a sudden hæmorrhage during the night of 29/30 June terminated a career already marked by solid achievement and full of promise for the future. Not France alone, but the whole civilised world is the poorer for this tragic loss, which, to those who enjoyed the privilege of de Vilmorin's friendship and thus had opportunities of appreciating at first hand the vigour of his intellect and the irresistible charm of his manner, is truly irreparable.

Clayton Beadle.—It is with great regret that we have to record the death of Mr. Clayton Beadle, on August 16th last. Mr. Beadle's name and work is familiar to readers of the *Bulletin* especially in connection with *Hedychium coronarium* and its value for paper-making. It was only this spring (*K. B.* 1917, p. 103) that we received from him for publication an interesting account of the plant growing semi-wild in Brazil, where he had recently been studying its growth with a view to its commercial possibilities. Mr. Beadle was always willing to place the resources of his laboratories at the service of Kew for the examination of any problems connected with cellulose or rubber.

Presentation of drawings.—Three interesting drawings of *Pinguicula vulgaris*, and *P. grandiflora*, found in Co. Cork and

Co. Kerry, and *P. lusitanica* from Valentia Island, by the late Miss Susan Lecky, have been presented to the Royal Botanic Gardens, and have been added to the collection of water colour drawings now exhibited in the North Gallery.

The drawings were made by Miss Lecky about 55 years ago, when she was living on Valentia Island, Co. Kerry, and have been presented by her brother, Mr. John Lecky, of 17, Hazlewell Road, Putney. Miss S. Lecky was born in Cork, in 1837, and died in London in 1896. She received much advice and encouragement in her work from the late E. W. Cooke, R.A.

Darwin Letters.—Sir William Thiselton-Dyer has presented to the Library a collection of about a hundred personal letters addressed to him by Charles Darwin between the years 1873 and 1881. Most of these are entirely in Darwin's own handwriting. Several, apparently dictated, are signed by Darwin, and some of these contain autograph postscripts. Those of more general interest have been published in "The Life and Letters of Charles Darwin", edited by Francis Darwin (1887), and in the supplementary volumes which appeared in 1903. The first letter, dated December 4, 1873, is a request for the identification of a specimen of *Cassia*, and this, like most of the others, is connected with those biological problems to the investigation and elucidation of which Darwin was devoted. "It is a dreadful evil to be so ignorant of botany as I am", he wrote in June, 1874, and on appealing for information he not infrequently concluded his letter with the expression—"Forgive me for being so troublesome". But the letters are far more than mere requests for or acknowledgments of help; they often contain allusions to experiments and discoveries of the utmost interest and importance. The last letter, dated November 16, 1881, about five months before Darwin's death, refers mainly to species of *Euphorbia* and *Asclepiadaceae* of which he was in need of material. The letters constitute a very valuable addition to the now extensive collection of original documents preserved in the Kew Library, and they are especially prized as a record of the service that Kew was able to render to our great biologist.

Gender of Sabal.—Good authorities regard it as neuter, while others equally good make it feminine. Adanson, who founded the genus, gave no indication as to the origin of its name, and having made no species supplies no help as to the gender. The first specific name showing gender was neuter (*S. carolinianum*). Sprengel, Steudel, the Index Kewensis, with a few exceptions apparently due to oversight, and the second edition of the Kew Hand list of Tender Monocotyledons (the first edition had feminine terminations) have neuter terminations. Martius (Historia Palmarum), O. F. Cook, and, amongst many others, Beccari, the author of the most recent and most important work

on the genus, have made all the specific names uniformly feminine. They do not give any explanation.

According to several writers Sabal is a South American or Mexican word.

Botanical Magazine.—The following plants are figured in the numbers for January, February and March: *Amorphophallus Kerrii*, N. E. Brown (t. 8692) from Siam; *Cytisus albus*, Link (t. 8693) from Spain and Portugal; *Cotoneaster salicifolia*, Franch. var. *rugosa*, Rehd. et Wils. (t. 8694) from Central China; *Quercus densiflora*, Hook. & Arn. (t. 8695) from N. America; *Rhododendron discolor*, Franch. (t. 8696) from Western China; *Maurandia Purpusii*, T. S. Brandegee (t. 8697) from Mexico; *Senecio Monroi*, Hook. f. (t. 8698) from New Zealand; *Pilea Forgeti*, N.E. Br. (t. 8699) from Venezuela; *Anguloa Cliftonii*. Rolfe (t. 8700) from Colombia; *Berberis Stapfiana*, C. K. Schneider (t. 8701) from China; *Clematis Fargesii*, Franch. var. *Souliei*, Finet et Gagnepain (t. 8702) from China; and *Mesembryanthemum Pillansii* (t. 8703) a native of South Africa.

In the numbers for April, May, June the plants figured are: *Rubus illecebrosus*, Focke (t. 8704) from Japan; *Senecio Hectori*, Buch. (t. 8705) from New Zealand; *Chirita Trailliana*, Forrest et W. W. Smith (t. 8706) from South-west China; *Saxifraga manshuriensis*, Komarov (t. 8707) from Manchuria and Corea; *Corylopsis Willmottiae*, Rehd. et Wils. (t. 8708) from Western China; *Vanda luzonica*, Loher (t. 8709) from the Philippine Islands; *Pyrola uliginosa*, Torr. & A. Gray and *P. bracteata*, Hook. (t. 8710 A & B) from N. America; *Plagiospermum sinense*, Oliv. forma *brachypoda* (t. 8711) from Manchuria; *Myrsine africana*, Linn. (t. 8712) found in Africa, India, and China; *Aesculus turbinata*, Blume (t. 8713) from Japan; *Stauropsis Imthurnii*, Rolfe (t. 8714) from the Solomon Islands; *Campanula Ephesia*, Boiss. (t. 8715) a native of the province of Aidin, Asia Minor; and *Disanthus cercidifolia*, Maxim. (t. 8716) from Japan.

Physiological Diseases of Plants in Nigeria.—The Annual Report on the Agricultural Department of the Southern Provinces of Nigeria for 1915 contains a summary of the results of some interesting experiments on physiological diseases of cotton and ground-nut. The diseases concerned are "leaf-curl" of native cotton and "bunching" of ground-nut, both of which were described in detail in the Mycologist's report for 1913.

The experiments indicate the important part played by the factors of soil-moisture and high atmospheric humidity in connection with physiological disturbances of this nature. As the following extracts from the report show, the two diseases in question appear to be affected in different ways by the same set of conditions:—

"The 'leaf-curl' disease of native cotton, which is prevalent in all the principal cotton-growing districts in the Southern

Provinces, does not appear to affect cotton grown in the rain-forest belt or near the coast, where more humid atmospheric conditions obtain. A series of plantings of native cotton was therefore made at intervals of approximately three weeks, from the beginning of March until the end of July, primarily to find out whether plants raised when the rainy season is well advanced, and during a period of comparatively high atmospheric humidity, would be susceptible to 'leaf-curl.' It was found that cotton planted as the rainy season advanced, up to the end of July, was least affected by 'leaf-curl.'

"It was suspected that the 'bunching' disease of ground-nuts was nearly allied in character to the native cotton 'leaf-curl,' but the results of experiments conducted during the year have given cause for a modification of this view. A series of ground-nut plantings was also made to test the humidity effect. These experiments showed that, by planting at the end of April instead of two months later, not only was the 'bunching' entirely prevented, but the yields increased to a remarkable degree, comparable with those obtained in any country where ground-nuts are produced. The difficulty of explaining why earlier planting eliminates 'bunching' is intensified by the fact that the ground-nut is a leguminous plant, and lives in symbiosis with its root-nodule organisms. Whether the ground-nut or its symbionts or both are adversely affected by too late planting remains to be proved."

A. D. C.

Potatoes grown from single eyes.—The shortage of seed potatoes in the spring of 1917 created a good deal of discussion in the Press as to the advisability of cutting tubers for planting into small sections instead of planting them whole. In order to test certain assertions as to the heavy yield from small scraps of tubers containing single eyes, the following experiment was conducted under conditions available to every allotment holder.

In January 1 lb. of tubers of Kerr's Pink and $3\frac{1}{2}$ lbs. of tubers of Lochar were obtained from Scotland. The Kerr's Pink were very small and were 15 in number. The Lochar were much larger, the exact number was not kept. All were at once placed in boxes and put in a light room from which frost was just excluded. Little progress in sprouting was made before the beginning of March so the boxes were placed in a warmer room for a fortnight. The sprouts were by that time $\frac{1}{4}$ in. long. The tubers were then cut into sections with one eye each except in the case of the five largest tubers of Lochar which were left whole. In this way 51 single-eye sections were procured from Kerr's Pink and 80 single-eye sections of Lochar.

The eyes were then placed in boxes of leaf mould and sand and lightly covered. They were stood in a light room in which there was a fire for several hours each day, but the boxes had eventually to be placed in a cold shed to check too rapid growth, the weather being too inclement for planting.

The ground used was part of an old market garden that had been more or less derelict for several years. It was very heavy and dirty and it had to be dug when very wet. In that condi-

tion it was too sticky to break up well and when dry it became very hard and lumpy. Planting could not be undertaken until April 20th, and on account of the poor planting condition of the soil a little fine soil from an old rubbish heap was placed in the trenches with the sets. The rows were planted 28 in. apart and the plants were placed 14 in. apart in the rows, and covered by about 3 in. of soil. The first shoots appeared above ground on May 1st, and from that time the plants grew vigorously. Before earthing up a little guano was sown between the rows but no other manure was given.

About the middle of July, and again during the second week in August, they were sprayed with Burgundy mixture but the tops did not show signs of disease. In both cases the haulms were very vigorous.

Lochar was lifted on September 15th, and yielded 197 lbs. of tubers. The largest tuber weighed 13½ ozs., and there were many between 8 and 10 ozs. There were 27 lbs. below seed size and 12 small tubers were diseased. Many tubers were affected with scab. Of the five large uncut tubers one was cut into two equal pieces at planting time, the others being planted whole. There was no difference at lifting time between the whole and the half tubers, but they bore heavier crops than the single eyes. The six sets yielded 24 lbs. 10 ozs. of tubers, but there was a large percentage of very small potatoes, each root numbering over 100 tubers.

Kerr's Pink was lifted on September 22nd and each root was weighed separately. The total yield was 157 lbs., the heaviest root yielding 7 lbs. 13 oz. Two other roots yielded 5 lbs. and 5 lbs. 10 ozs. respectively, whilst other 10 roots produced 4 lbs. or more each. Sixteen roots bore between 3 and 4 lbs. each and but two roots yielded below 1 lb. each. Those two roots were always rather weak and the tops were eventually killed by their stronger neighbours. They produced but 6 and 7 ozs. respectively. The heaviest tuber weighed 15½ ozs. and there were many tubers between 9 and 13 ozs. Seven pounds were below seed size. Seventeen tubers were affected with ordinary potato disease, and many were marked with common scab in the same way as all the varieties of potatoes grown on the same ground.

More room ought to have been allowed both between the rows and the sets for the tops became very crowded by the end of July.

W. D.

Seeding and Planting in the Practice of Forestry.*—This work is dedicated to the graduates of the Yale School of Forestry and deals primarily with forestry in the United States of America although it will be found a useful book not alone to forestry students in the United States but to foresters elsewhere, for much of the matter is suitable for general application.

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* Seeding and Planting: a Manual for the Guidance of Forestry Students, Foresters, Nurserymen, Forest Owners, and Farmers. By James W. Toumey, M.S., M.A., Director of the Forest School and Professor of Silviculture, Yale University. Published by John Wiley & Sons, Inc., New York, and in London by Messrs. Chapman & Hall, Ltd. Price 16s. 6d.

In an introduction of 14 pages the past and present conditions of forestry in the United States are briefly discussed. The book, which runs to 455 pages, is then divided into two parts the first entitled "Silvical Basis for Seeding and Planting," and the second "The Artificial Formation of Woods." Each part is then divided into chapters dealing with special subjects which are again sub-divided into numbered sections with prominent headings to facilitate study.

Part i. deals largely with the formation of natural and artificial woods, their composition, etc., whilst the second part deals with seeds and seedlings from the collection of the seeds through the periods of storage, testing, sowing, transplanting, and nursery care of seedlings, to their planting in permanent positions. In this part considerable attention is also given to planting sites and their preparation for planting.

A good idea of the thoroughness with which the book has been prepared may be gathered from the sub-headings to Chap. vii. Pt. ii., on "Forest tree seed and seed collecting," among which are the following :—

1. Demand for forest seed. 2. Sources from which seed may be obtained. 5. The origin of the seed in relation to quality. 6. The size and weight in relation to quality. 8. The average number of seeds per pound. 9. The number of pounds of seed per bushel of fruit and the cost per pound. 12. Variation in the keeping qualities of different species. 17. The determination of viability. 23. Kinds of germinating apparatus. 24. Germinating tests in soil. 25. Germinating tests in media other than soil. 31. Special treatment to hasten germination. 32. The average viability of commercial seed, etc.

Tables and photographs are introduced in various places to summarise and illustrate special subjects and the book throughout is dealt with in such a manner as to be both instructive and interesting. W. D.

Farm Forestry.*—This book, written by the Professor of Forestry at the Pennsylvania State College, U.S.A., is intended as a guide to the management of woods on farms and small estates rather than a work on general forestry. Nevertheless it contains a great deal of information that is applicable to forestry in all its branches and deserves a place in the forester's library. The early chapters take a general survey of woods in connection with farms, the botanical characters of trees and their requirements, and the relationship of trees to the improvement of land, followed by chapters on various methods applicable to the establishment of farm woodlots, the conversion of timber from farm woods, the marketing of timber and the different properties of woods. Chapter xx. deals with the use of perishable woods for fence posts by treating with creosote, and ought to be of particular value to farmers both in the United States and in other countries. The chapter on the different properties of woods will also be found of considerable use by those people who are at a loss to know how to convert home-grown timber to the best advantage. Numerous illustrations add interest to the work.

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* Farm Forestry, by John Arden Ferguson, A.M., M.F., published by Messrs. Chapman & Hall, 11, Henrietta Street, Covent Garden, W.C. 2. Price 6s. net.

ENNEAPOGON MOLLIS.

To face page 217.]

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ROYAL BOTANIC GARDENS, KEW.

BULLETIN

OF

MISCELLANEOUS INFORMATION.

No. 6] [1917

XXI.—ENNEAPOGON MOLLIS IN ASCENSION ISLAND.

O. Stapf.

(With Plate.)

Sir Joseph Hooker in his "Lecture on Insular Floras" gives the following description of Ascension and its vegetation:—

"St. Helena has been called a barren rock, but it is a paradise as compared with Ascension, which consists of a scorched mass of volcanic matter, in part resembling bottle glass, and in part coke and cinders. A small green peak, 2800 feet above the sea, monopolises nearly all the vegetation, which consists of Purslane[1], a grass[2], and a Euphorbia[3] in the lower parts of the island, whilst the green peak is clothed with a carpet of ferns, and here and there a shrub[4], allied to but different from any St. Helena one. There are nine ferns, of which no less than six differ from those of St. Helena, and three of them are entirely confined to the islet." This account takes only the endemic vegetation into consideration. To it has to be added a small number of plants which have more or less established themselves since the island has been inhabited and attempts at cultivation have been made. Large parts nevertheless have remained an absolute desert, especially along the coast and the lower parts generally. In June of this year, however, a remarkable change has been brought to our notice by the Director of Victualling, Admiralty, who sent to the Director a copy of a letter from the Farm Superintendent, Ascension Island, together with a specimen of a grass and the photograph here reproduced. In this letter the writer says: "You will be interested to know that a new grass has suddenly appeared in great abundance on the lower parts of the island. It first appeared to windward of the plain which the wide-a-wakes (sooty terns) frequent during their periodical visits, and has spread from there by the prevailing south-east trade wind to the Garrison

[1] *Portulacca oleracea*, L.
[2] *Aristida adscensionis*, L.
[3] *Euphorbia origanoides*. L.
[4] *Hedyotis adscensionis*, DC.

(5069.) Wt. 152—699. 1,125. 10/17. J. T. & S., Ltd. G. 14.

three or four miles on. It has quite altered the appearance of Garrison and the intervening country, and the horses and mules are being turned out to graze on it. I have made a small stack of hay on 'Wide-a-wake,' to test it as such, and many tons might have been put up if we had known it was coming and had been prepared for it.

"Whether the grass is a perennial and really useful remains to be seen, but the animals are extremely fond of it now. It is seeding freely, and should it grow again at any future time after favourable rains a large amount of hay might be made. It is climbing up the craters and turning them from red to green hills.

"I am posting with this a small piece of the grass as a specimen, and if you would kindly ask the Kew authorities how they class it I should be most pleased to hear their decision.

"The specimen is a short piece, but where the ground is better it grows 3 feet in height. It also grows on the brackish places which most things object to."

The grass has been determined as *Enneapogon mollis*, Lehm. (also known as *Pappophorum molle*, Kunth). It had not been recorded from Ascension before, but was known to occur on the coast of Angola and in Great Namaqualand, from which region it extends through the Kalahari Desert to Bechuanaland and Griqualand. It also inhabits the Sudan, parts of Abyssinia, Eritrea, and Somaliland and has been collected in Madagascar and once in the Punjab. It appears to be annual, as pointed out by Chiovenda (in Ann. Istit. Bot. Roma, viii. 358, sub *Pappophorum abyssinicum*), but the occasional presence of tardily flowering innovation shoots sometimes gives it the appearance of a perennial. It is a typical desert grass. It grows in the palm groves of Loanda Island, according to Welwitsch (Cat. Afr. Pl. Welw. ii. 229, under the name of *E. abyssinicus*, Rendle), in dense masses and covers wide areas, and Gossweiler says of it, in a note accompanying one of his specimens, that around the town of Loanda—sandy arid soil—it springs up after rainy days. Like most annuals, it shows great fluctuation as to size according to the fertility or sterility of the soil and the water supply. Particularly robust specimens, collected in the Hissar District in the Punjab in 1886—possibly as a casual introduction—were described as a new species, *Pappophorum robustum*, Hook. f. The dispersal of the grains is much aided by the extreme lightness and the feathery awns of the florets, which on maturity become detached and, with the grain tightly enclosed in them, may be carried over wide distances by the wind or by birds and other animals to which they would readily adhere. They would cling equally well to clothing or packing materials, and thus be dispersed by human agency. Once established under suitable conditions there seems to be no reason why the grass should not reproduce itself regularly, although in an excessively arid climate the grains might remain dormant in rainless years. No precise information concerning the economic value of the grass is available, but there is little doubt that it would be a valuable asset in any arid country. It may be remarked in support of this contention that

Major R. Gordon, of Lochinvar Monze, North Rhodesia, found the similar and nearly allied grass *Schmidtia bulbosa*, Stapf, a most valuable fodder for his horses when during the South-West African campaign of 1915 they had to subsist on it almost exclusively during long forced marches. As *Schmidtia* is a perennial grass and grows under similar conditions to this *Enneapogon*, it might be worth while to try to establish it in Ascension Island.

A similar photograph to that reproduced and a specimen of the grass has also been received from Ascension through a private correspondent, who writes: "Rain is a very rare occurrence, but some months ago they had most bountiful showers, and immediately the island blossomed into green verdure." In a further letter the writer, who knows the island well, states that he believes the recent rain is the first within living memory, and that he has never seen a blade of grass on the island except on the mountain tops, where there is almost a perpetual mist.

XXII.—BARK CANKER IN HEVEA BRASILIENSIS.

A. Sharples,
Mycologist, Department of Agriculture, Federated Malay States.

Phytopathological problems in connection with *Hevea brasiliensis* present many curious features. Bark canker caused by *Phytophthora Faberi* has been considered the most serious disease in Java by Rutgers (7) since 1912, and Petch (4) in Ceylon obtained successful inoculation experiments on rubber with *P. Faberi* taken from diseased Cacao pods in 1910. Bark affections, as described from Java and Ceylon, were not, however, reported in Malaya before 1916, and it was not until late in 1916 that serious outbreaks were noted. During 1916 Dastur (3) carried out extensive observations on *P. Faberi* in Burma, and the conclusions drawn from his laboratory experiments are interesting when taken in conjunction with Malayan observations.

P. Faberi on Cacao and Cross Inoculations on Rubber.

Rorer (6) settled the question of the cause of Cacao canker by careful inoculation experiments, proving that *P. Faberi*, Maub., was undoubtedly responsible. Petch (loc. cit.) in 1910 following on Rorer's work, inoculated ten *Hevea* stems with *Phytophthora* spores obtained from diseased Cacao fruits and three more by inserting pieces of diseased Cacao pods in wounds. Six of these thirteen inoculations gave definite infections, and he concluded that canker and pod disease of *Hevea* are caused by the same *Phytophthora* which is responsible for the stem canker and pod rot of Cacao—viz., *Phytophthora Faberi*, Maub.

These observations tended to disprove Carruthers' (2) conclusion that *Hevea* canker was caused by a species of *Nectria*. The matter was left in an unsatisfactory state, for the inoculations carried out by Petch were too few in number, and objections could be raised against the method adopted. Rutgers (loc. cit.).

working independently in Java, carried on the work much further, and his conclusions supported those of Petch as to the cause of bark canker of *Hevea brasiliensis*.

Investigations in Java by Rutgers.

Rutgers investigated bark canker of *Hevea brasiliensis* in great detail and contributed valuable information regarding the various manifestations caused by *Phytophthora Faberi* on diseased bark. He showed by large numbers of inoculation experiments that the symptoms manifested depend largely as to whether untapped or renewing bark is attacked. The infection takes place on the tapping cut, and if the fungus enters the renewing bark, 'Streepjeskanker' or Line-canker (Form A) is the result; if the untapped bark is affected 'Vlekkanker' or Spot-canker (Form B) is observed.

Rutgers describes his observations on Spot-canker in detail B, C, D (loc. cit.):—

(B. Spot-canker):—The second acute form of canker is the appearance of moist, dark-red (sometimes reddish-brown or reddish-grey) spots in the bark, usually beginning at a cut. They are not visible till the outer cork of the bark is removed. If the bark is removed we find, not the green colour of the outer living bark (phellogen), but a black layer, and below it a damp dirty-red canker spot is found sharply defined from the surrounding healthy yellow bark. If these diseased spots are not treated in time they reach a great size and kill the bark down to the wood, while in bad cases the whole tree may be ringed. The diseased spots yield no latex when cut, though the healthy surrounding tissue does sometimes yield an unusual quantity.

(C). Sometimes the red canker spots described under (B) have only a limited spread, but a discoloration is found in the inner bark close to the cambium. This form is usually less striking than Form (B) but the infection proceeds further. It appears on the cut in dirty brown or grey lines and spots, sometimes also as a brown layer in place of the cambium. A typical mark of this form of canker is the complete drying up of the cuts within the discoloured area.

(D). If the cases included in (C) are not treated they may lead to very noticeable swellings, *i.e.*, "Burred trees." The grey lines and spots are dead cells or latex receptacles with coagulated latex, in the midst of living bark tissue. Under certain circumstances not yet known these dead cells cause the surrounding cells to split up and produce a secondary cambium that forms wood around the dead cells. This working of the secondary cambium leads to the formation of lumps of wood (burrs) in the bark, originally quite loose from the central wood of the trunk, and differing in form according to the number and position of the dead cells which cause them. This wood sometimes appears in small round bullets like the "peas" found on healthy trees; sometimes from the beginning large plates of wood are formed. If these wood formations are not treated in time they continue to increase in size and thickness and may develop alarming dimensions. This is the origin of the trees

deformed by great bark swellings which can be found on almost any old *Hevea* estate. As the swelling increases in size the bark bursts and displays hollows in which sometimes considerable quantities of latex are coagulated; whole sheets of rubber are occasionally found under such deformed bark. The yield of latex is exceptional at this stage, but tapping is almost impossible.

Rutgers's inoculation experiments showed that *Phytophthora Faberi* attacks the renewing bark, forming small vertical black lines above the tapping cut. This is the Line-canker (Form A), to be described below.

Petch's Observations in Ceylon.

Petch has studied *Hevea* canker in great detail in the field, and his final observations on the attacks of *Phytophthora Faberi* in the untapped bark agree with those of Rutgers. An affection of renewing bark was noted by him, the description of which agrees in all respects with that of (Form A) Line-canker of Java; but he considered this decay of the renewing surface to be caused by an excess of moisture on the layer exposed to the rain during tapping, and not to any pathogenic cause, as he failed to reproduce the decay by means of organisms found in the decayed bark. Later Bryce (1) stated that this decay in Ceylon could be ascribed to physiological causes, though Dastur had proved that similar symptoms described as Black Thread in Burma were caused by *Phytophthora Faberi*.

Dastur's Investigation in Burma.

In 1916 Dastur (3) published two articles recording his observations on a decay of renewing bark of *Hevea brasiliensis*. The symptoms are locally known as Black Thread and are similar to those described by Rutgers as (Form A) Line-canker caused by *P. Faberi*, and to those shown in the rotting of the renewing bark in Ceylon, the cause of which Petch did not determine. The symptoms are described as follows by Rutgers:—

A. Line-canker:—The easiest to recognise are the vertical dark lines in the new bark over the cuts. In unusual rain and damp this form of canker sometimes appears as an epidemic on a large number of cuts. In the bark healing over the cuts, fine vertical black lines appear, beneath which a broader discoloration penetrates to the wood. These black lines, which are often numerous on one cut, soon become longer and broader and appear in the new bark as black, sunken, rotten spots, sometimes with grey fungus on the surface. If tapping is continued they spread and coalesce and the whole of the new-formed bark rots away. It may spread inwards into the untapped bark below the cut. If there is continued dry weather it ceases to spread. To begin with, the yield of latex in this form of canker is normal; later the affected cuts cease to yield.

In a severe drought different symptoms may appear which may lead to confusion. Wounds appear in the newly formed bark even with good tappers, who do not usually cut too deep. These are tapping wounds, as may be recognised from the fact that they follow the direction of the tapping. In dry weather it is not possible to tap as deep as in wet weather without wounding.

As Dastur states, this description clearly shows that Line-canker in Java is identical with Black Thread disease of *Hevea* in Burma, but he points out that it is not clear why Rutgers considers the two forms, *i.e.*, Form A and Form B (the latter including C and D described above) to be due to the same fungus, *Phytophthora Faberi*. For although he inoculated *Hevea* with *Phytophthora* obtained from Cacao and obtained the typical canker Form B in every case, yet when he inoculated *Hevea* with *Phytophthora* from *Hevea* he obtained the typical black vertical stripes of Form A. It is unfortunate that the *Phytophthora* found on *Hevea* has not been inoculated on Cacao either by Petch or Rutgers.

Diseases on Renewing Bark in Malaya.

Rutgers paid a short visit to Malaya during 1912 and reported, as a result of an inspection of burred trees, that Form D described above was present on Malayan plantations. This feature never assumed serious proportions and perhaps is now less noticeable than at the time of Rutgers's visit. Little attention was given to this manifestation. In 1916 two serious affections of renewing bark were under observation in widely separated districts of Malaya. One district is in North Perak, the other in the Negri Sembilan. Both districts are well inland, the affected estates being situated on undulating land.

Bark Canker (Black Stripe) in North Perak.

The symptoms of the N. Perak outbreak closely resemble those described for the Black Thread of Burma and the Line-canker of Java, but the blackening of the tissues along the whole cut as mentioned both by Dastur and Rutgers is seldom observed except in long neglected cases. The vertical black lines remain separate with an inch or two of healthy bark between the lines. The diseased tissue when cut into with a small gouge extends not only to the wood but penetrates deeply into it. Other observers have not recorded this penetration of the woody tissues; they simply state that it extends through the cambium into the wood without calling attention to the fact that this observation may be of fundamental importance in a consideration of treatment. In N. Perak, cases have been noted where there was no external indication beyond a small slightly discoloured spot, yet excision reveals the wood diseased to a depth of $\frac{1}{2}$ or $\frac{3}{4}$ of an inch with a vertical extension of one inch. The penetration in a radial direction must be very rapid, for cases have been examined showing discoloured wood to a depth of an inch which could only have originated from infections made seven to ten days previously if the infection takes place on the tapping cut. The fungus can be demonstrated in the discoloured wood at its deepest part. This radial penetration of the wood is so extraordinary that special attention was given to the progress of the fungus in the tissues. Dastur (3) states that the fungus seldom runs below the tapping cut in Burma though Petch and Rutgers record instances where the Black Stripe decay travels downwards to involve the untapped bark. These cases appear to be excep-

tional, but in N. Perak the fungus often progresses in the wood 1 to 2 inches below the cut The penetration of the wood is as rapid in the vertical as in the radial direction, but there is little lateral growth. As a result the Black Stripes remain localised; the fungus appears largely confined to the medullary rays in its passage through the wood.

These observations, coupled with the fact that a species of *Phytophthora* was isolated from diseased wood taken at a depth of $\frac{3}{4}$ of an inch in the stem, are significant. Numerous isolations were made which all turned out pure cultures of the same species of *Phytophthora*. The isolation of *P. Faberi* from decaying bark on the renewing surface has presented some difficulty to previous observers and when attempting to prove the incidence of the disease they have utilised pure cultures obtained from diseased seed pods for inoculating experiments. Time would not permit a comparative study of the fungus to determine whether it agreed with the description of *P. Faberi* but it may be stated with some degree of certainty that a *Phytophthora* is responsible for the symptoms observed in N. Perak.

Bark Canker symptoms in Negri Sembilan.

The Negri Sembilan outbreak, though an infection of renewing bark, shows different symptoms to that in Northern Perak and if a determination of the disease depended on a comparison of external signs there would be justification for stating that two different bark diseases occur in Malaya. In this case there is practically no penetration of the wood; the active radial and vertical growth in the wood so characteristic of the N. Perak fungus is missing. Apart from the absence of Black Stripes the outbreak corresponds to Bark canker as described from Java and Sumatra. Pratt (5) in Sumatra describes bad cases in which "individual black lines are not apparent, the whole of the tapping cut turning black." He makes no reference to the disease pentrating into the wood. In Negri Sembilan the renewing bark is attacked, not in lines, but in patches just above the cut. The descent of the cut owing to tapping is usually more rapid than the downward growth of the fungus, so that after a few days a black, disorganised area of bark tissue is found covered with a greyish-white bloom running roughly parellel to the tapping cut. The greyish-white bloom is caused by a growth of saprophytic fungi, a species of *Cephalosporium* predominating. Dastur (3) says that in Burma the decaying bark is soon overrun by saprophytic fungi like *Fusarium*, *Cephalosporium* and *Spicaria*. especially the first. If the attack is neglected, the fungus spreads and the tissue down to the tapping cut becomes black and diseased.

Old cases never showed the fungus growing in the woody tissues except in the external elements, and black lines were never observed penetrating the wood, though another observer has seen indications of their presence. Isolation experiments carried out over several weeks before the writer's departure from Malaya on leave showed no indications of the presence of a *Phytophthora*.

Attention is directed to the differences in the nature of the two attacks. According to the descriptions from other countries of the activities of *P. Faberi* in the bark of *Hevea brasiliensis*, this fungus might be considered responsible for both Malayan outbreaks. The essential differences are such that the evidence practically justifies the conclusion that two different fungi are operating. In N. Perak a *Phytophthora* rapidly penetrates the wood in a radial and vertical direction with practically no lateral extension. Assuming the Negri Sembilan outbreak to be caused by the same fungus it is remarkable that under similar conditions, the fungus does not penetrate the wood, but is confined entirely to the bark, extending quickly in a lateral direction. Dastur has evidently met some difficulty in reconciling the available evidence to the view that the one fungus, *Phytophthora Faberi*, is responsible for the varied bark troubles in rubber in the Middle East.

He says (3) "It seems clear that we have in *Hevea* two different species of *Phytophthora* causing two distinct kinds of diseases instead of one fungus causing two distinct symptoms of one disease. Of these two different species one is *P. Faberi* which causes *Hevea* canker identical with that of Cacao as shown by the inoculation experiments of Petch and Rutgers; and the other species causes Streepjeskanker or Black Thread disease as seen from the inoculation experiments made by Rutgers in Java and me in Burma."

Malayan observations are important in the light of this statement. The writer had no opportunity of pronouncing upon the identity of the *Phytophthora* isolated from N. Perak specimens, but it would be interesting to know whether it agreed with *P. Faberi*, Maub. in order to test Dastur's conclusion. As far as the records go, there appears to be no previous case where the *Phytophthora* has been isolated in pure culture from the diseased tissues.

These observations are placed on record only to show investigators in other rubber-growing countries that the present position is most unsatisfactory, and that the subject calls for further patient investigation. Recommendations for combating the disease depend on our knowledge of the causal fungi and their *modus operandi*. Methods as recommended in Java have been tried in Malaya but were found to be valueless. Dastur does not seem convinced of the efficacy of measures previously recommended by other investigators and our advice in Malaya, where strenuous measures are necessary, has been generally to treat each individual case on its merits. Little progress can be expected until an investigation of Bark diseases in the different rubber-growing countries has been made by an observer with opportunities to investigate the problem in all places where Bark disease is prevalent. For Malayan plantations the question is a serious one as is indicated in the following article.

A more detailed account with measures adopted to combat the Malayan outbreaks has been written for the Agricultural Bulletin, Federated Malay States.

(1). Bryce, G.—Report of the Acting Botanist and Mycologist. Tropical Agriculturist, xlvii, No. i. 1916, p. 29.
(2). Carruthers, J. B.—Canker (Nectria) of Para Rubber (Hevea brasiliensis) Circs. & Agric. Journ. Roy. Bot. Gard. Ceylon, ii, No. 29, 1905, p. 445.
(3). Dastur, J. F.—Phytophthora sp. on Hevea brasiliensis. Mem. of the Dept. of Agric. in India. Bot. Series, Vol. viii, Nov. 1916.
(4). Petch, T.—Cacao and Hevea Canker. Circs. & Agric. Journ. Roy. Bot. Gard. Ceylon, v, No. 13, 1910, p. 166.
(5). Pratt, H. C.—Preventive Measures against Black Thread.—(Phytophthora Faberi). Agric. Bull. Fed. Malay States, Vol. v, Nos. 5–6, Feb. & Mar. 1917.
(6). Rorer, J. B.—Pod-Rot, Canker and Chupon-Wilt of Cacao caused by Phytophthora sp. Bull. of Trinidad Dept. of Agric. ix, No. 65, 1910, p. 91.
(7). Rutgers, A. A. L. & Dammerman, K. W.—Diseases of Hevea brasiliensis in Java. Med. van het Lab. von Pflantenziekten, No. 10, pp. 27–33.

XXIII.—THE SIGNIFICANCE OF DISEASES IN THE ECONOMY OF MALAYAN RUBBER PLANTATIONS.

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The fungus diseases of *Hevea brasiliensis* have been actively investigated during the last six years. The situation in Malaya, where rubber is practically the only agricultural product, lends itself to intensive research, and pathological investigations over several years have been confined to observations on *Hevea brasiliensis*. Much information has been gained regarding the action of fungi attacking rubber trees, especially since 1913, but it is only during the last twelve months that a statement regarding the ultimate effect of disease upon the economy of Malayan plantations could be made. The significance of the researches on fungus diseases of *Hevea brasiliensis* will be better realised if taken in chronological order.

At the beginning of 1913 when the writer reached Malaya the only serious troubles were those caused by the root fungus, *Fomes lignosus*, Klotzsch, and by White Ants. The die-back caused by *Diplodia cacaoicola*, P. Henn., had been investigated thoroughly by Bancroft (1) but this disease had never caused alarm on the plantations. During 1913 the chief feature on Malayan plantations was the rapid spread of Pink disease and the absence of bark diseases; the latter had been investigated in Ceylon by Petch and in Java by Rutgers, and shown by the latter to assume serious proportions on some rubber plantations in Java.

In 1914 Mr. F. T. Brooks was appointed Mycologist to the Department of Agriculture, Federated Malay States, and an energetic search into the cause and spread of Pink disease was started. Towards the end of 1914, Brooks established *Ustulina zonata* as the cause of a root and collar disease on *Hevea brasi-*

liensis. A vain search for bark diseases caused by *Phytophthora Faberi* was conducted throughout the year, but up to the end of 1914 when Brooks left for England there was no cause for uneasiness.

Investigations on the disease caused by *Ustulina zonata* were carried forward, and in 1916 serious attacks by this fungus were noticed. About the beginning of 1916, Belgrave (2), who was appointed Assistant Mycologist just before Brooks left, commenced investigations on a wet rot of *Hevea* roots, which appeared quite distinct from the dry root-rot caused by *U. zonata*. A preliminary statement of his work has been given (2) but the full account has not yet been published.

The following cases of serious attacks of root disease may be quoted:—(A) The Government plantation behind the offices of the Department of Agriculture at Kuala Lumpur carries about seven acres of 15-year old trees. A fair number of trees attacked by *Ustulina zonata* were known, but only one small group of six trees was known to be affected with wet root-rot. To obtain specimens and observe the disease below ground, this group together with the neighbouring trees, was opened up. It was obvious from the commencement that the subterranean spread of the disease was much greater than at first anticipated. The roots of two hundred and twelve trees were exposed and 40 per cent. showed diseased roots, largely caused by the fungus producing wet root-rot. The matter was so serious that at the request of the Advisory Committee to the Department of Agriculture, all the trees in the seven acres of old rubber had their roots exposed, and of the 700 trees in the whole area 20 per cent. showed diseased roots.

(B) Another illuminating case was noted a few months ago. A wind storm locally known as a "Sumatra" swept over a portion of one estate and numbers of 17-year old trees were blown over. Only three of these prostrate trees showed healthy roots, and these were without tap roots. A few of the fallen trees had previously been treated for *U. zonata*, but the great majority, which were not suspected to be suffering from root diseases, were found to have this fungus attacking the roots. A few cases of branch infections with *U. zonata*, and a few trees with wet root-rot were also found. When the place is cleared huge gaps must be left in the wind-swept area. The manager expresses his conviction that any other portion of the old rubber on his estate subjected to a similar storm would show a large number of unsuspected cases of root disease. These cases show the insidious spread of these root fungi on old rubber, and it is impossible to urge too strongly the necessity for immediate and strenuous measures to keep them under control.

The necessity for active sanitation measures in Malaya is apparent to all who have studied the accounts of these root-rots, but no justification existed for assuming that diseases of rubber need prove an active factor in inhibiting the development of Malayan plantations. In Malaya, diseases on the plantations have been effectively combated by growing more trees per acre than are absolutely necessary, at the same time avoiding over-

crowding. This results in a diminished amount of light and air, i.e., free ventilation, reaching the trees. This factor does not influence the spread of root-rot on old trees to an appreciable extent and if bark renewal is not interfered with, losses owing to root disease can be compensated for.

If free ventilation becomes necessary in the plantations this satisfactory method of allowing for diseased trees cannot be followed. Investigations in rubber-growing countries other than Malaya show that free access of light and air is one of the essential conditions in combating Bark diseases of *Hevea brasiliensis*. Bark diseases were practically unknown in Malaya up to 1916 and as long as serious bark affections were not reported the position could be considered satisfactory.

The previous article gives a short account of the serious outbreaks of Bark disease observed in Malaya in 1916. Treatment necessitates a vigorous thinning-out to the minimum number of trees per acre commensurate with profitable working. This number might be termed the "working number," for convenience.

Conditions for the spread of fungus diseases are probably more favorable in Malaya than in any other rubber-growing countries. The atmospheric humidity is always high; there is no pronounced dry season when disease-producing fungi lie dormant which enables planters in Ceylon and Java to control diseases, especially those of the bark, more easily. The plantations are opened from virgin jungle, and as a consequence there are large numbers of jungle stumps and logs left in the ground to encourage disease. The troublesome root-rots in Malaya all originate from rotting jungle timber and stumps. Thus countries like Ceylon and Java, where large acreages of rubber are grown on land which has been cultivated for several hundred years, have a considerable advantage, for the original jungle stumps and timber have long ago disappeared, and there is little chance of the root-rots appearing unless previous crops were attacked by the same fungi. Fungus diseases again are always most dangerous where there are large acreages under one crop, for no obstacles to the passage of spores exist unless jungle belts are interposed between the cultivated areas. In Malaya the whole of the peninsula is under rubber, and though jungle belts are provided they are not wide enough to be effective in preventing the spread of fungus diseases. Pink disease is a case in point; the fungus causing Pink disease reported from three small centres in 1912 had spread practically over the whole peninsula by 1914.

These facts are brought forward to support the view that there is every chance of Bark diseases spreading and becoming general throughout Malaya, and to indicate that the experiences of Malayan planters are likely to be different from those of Ceylon and Java. Experience obtained in the latter countries cannot be quoted as necessarily applying to Malaya.

Until the discovery of bark diseases Malayan plantations could compensate for disease losses by keeping more than the "working number" of trees per acre. This position is now untenable

for the conditions for the spread of disease are so favourable that we may expect bark diseases to become general in the peninsula. Then if the root-rots are active—and these are already very generally distributed—the number of trees per acre may be so reduced that the best results will not be forthcoming, in fact, may make all the difference between profitable and unprofitable working.

Competition may now be considered. Plantation rubber reigns supreme, though there are possibilities of a cheap synthetic rubber. A great demand for rubber may be anticipated after the war, which will stimulate enquiry into the synthesis of rubber, and much activity may be expected in this direction. A commercial synthetic rubber may possess intrinsic properties which will make it valuable in the arts and manufactures, but if proper foresight is used to develop the plantations along scientific lines plantation rubber should never fear competition from the synthetic product.

The menace to the present plantations is disease.

In Malaya the question is specially serious. "The menace of disease in Malayan plantations is still potential, but it may prove the limiting factor in the development of the plantations if a serious competitor arises. If preventive measures are not undertaken the menace may become dynamic and prove the ultimate ruin of Malayan plantations."

The researches conducted in Malaya have impressed practical men in touch with the work of the Department of Agriculture. The need for sanitation measures is generally recognised, and the planters who disbelieve in their necessity and still endeavour to refute the idea of disease becoming a serious matter are few, an attitude very different to that recently held. Active clearing work is in progress on most plantations which can spare money and labour. The methods recommended to combat diseases of rubber in Malaya can be found in the special bulletins issued by the Department of Agriculture, and this article is intended as an introduction to suggestions which should be taken up and vigorously supported by institutions or by influential men interested in the rubber plantations of the Middle East.

To guard the future of the Malayan industry investigations along two lines, practically untouched up to the present, are of first importance. In the first place, a physiological investigation is needed to discover the role played by the latex in the metabolic processes of the plant, and also to ascertain in what measure the extraction of latex interferes with the full development of the tree. An investigation of this nature should provide information required to settle many controversial matters regarding tapping methods and should lead to an intelligent view of planting, which would supersede the present haphazard methods. The second line of investigation is that of seed selection, not only with the view of obtaining better yielding trees but also with the object of raising a strain of stronger and hardier trees, which would be more resistant to disease. Intelligent men interested in the rubber industry realise the necessity for immediate researches along these two lines. The outstanding ques-

tion, however, is largely one of the proper ways and means to reach the desired end. Both lines of investigation are purely scientific as regards their methods, and could best be carried out under the control of a properly organised Government Department which would ensure that the investigators could pursue their researches without interference from those interested only in obtaining immediate practical results.

(1). Bancroft, C. K.—Die-back fungus of Para Rubber and of Cacao. Bull. Nos. 9 & 14; Dept. of Agr., Fed. Malay States.
(2). Belgrave, W. N. C.—Root disease of Plantation Rubber in Malaya. Agric. Bull. Fed. Malay States, Vol. iv, No. 11, Aug. 1916.

XXIV.—THE PRESERVATION OF LEAFY TWIGS OF THE BEECH.

L. A. Boodle.

As the autumn colouring of the common beech shows some pleasing shades, such as golden-brown and chestnut-brown, leafy twigs of this tree with autumn tints are sometimes used for indoor decoration, the cut ends of the specimens being kept in water. After a week or two the leaves usually begin to crumple or to fall. Shrivelling of the leaves naturally takes place much sooner if the twigs are not supplied with water.

Some commercial value might attach to the preparation of specimens by an easy method of treatment which would make it possible to keep them without water while preserving the natural appearance of the leaves and giving them a colour like that of an autumn tint. A suitable method appears to have been devised, since twigs of beech with brown foliage, treated so as to keep the leaves from shrivelling, are sometimes offered for sale at shops. On examining one such specimen it was found to have been treated with some hygroscopic substance, while the brown colour was due to a dye, the twig having been gathered when the leaves were still green.

Some experiments have been made with the object of finding an easy method of obtaining a similar result. In these experiments calcium chloride was tried as a hygroscopic agent to prevent withering, and the possibility of using it successfully has been demonstrated.

The material experimented on consisted of large and small freshly cut beech twigs bearing green leaves, and was gathered in September, 1916. A series of experiments was made by placing the cut ends of the twigs in a watery solution of calcium chloride and leaving them for some days, the lower ends being trimmed every day or two, so as to present freshly cut surfaces to the liquid. Different strengths of solution were tried, and the treatment was continued for three, seven, or eleven days. Some of the specimens were exposed to bright sunlight for several hours during their treatment, while others were kept where only diffused light could reach them.

The results show that permeation of the internal tissues of the leaves with calcium chloride can be obtained by this method. The action of the treatment may be explained as follows: The solution is at first drawn up to replace the water lost by the transpiration of the leaves. Then death of the leaf-tissues occurs sooner or later after calcium chloride solution of a certain strength has reached them. An upward current of the liquid may, however, continue for some time after the leaves have been killed, especially if a weak solution is being used and if the specimens are exposed to sunlight.

Four strengths of calcium chloride solution were tried, having specific gravities of 1·05, 1·1, 1·2, and 1·4,* the strongest of these representing a nearly saturated solution at 60° F. The liquids were prepared with the aid of a hydrometer, and were filtered before use.

The best result as regards resistance to withering was obtained with the two stronger solutions (sp. gr. 1·4 and 1·2), the treatment being continued for a week with exposure to sunlight for some hours. The specimens treated in this way were in good condition after being kept for six months, and showed only slight curling of a few of their leaves.

Experiments with the weaker solutions were less successful, but were not sufficiently numerous or varied to prove that weak solutions are unsuitable. A branch of copper beech was treated with 1·05 solution for eleven days, and remained well preserved for a considerable time. After six months most of the leaves showed slight curling, though not enough to spoil the appearance of the specimen. One or two twigs of the common beech, similarly treated, were still less successful, as the leaves showed decided crumpling after a few weeks.

The length of time required for the treatment with a given strength of solution will depend partly on the dryness of the air and the degree of illumination, and probably to a great extent also on the nature of the specimen. Thus the sun—or shade—character of the leaves and the season at which the twigs are cut are presumably among the particulars concerned. In view of the uncertainty attaching to the length of time required, it is probably best to continue the treatment until waterlogging of the leaves is attained, or even rather longer. The waterlogged condition is easily recognised by the transparent appearance of the leaves. Exposure to sunlight is also recommended, as it was found to give the leaves a brownish colour, similar to an autumn tint, thus making dyeing unnecessary, unless other tints are desired.

In the case of the specimens treated with the two stronger solutions the treatment was continued for at least a day after waterlogging was observed. An exudation of liquid appeared on the lower side of the leaves of these specimens a day or two after the treatment with calcium chloride had been stopped. The twigs were therefore left a few days longer, then rinsed in

* In the case of the weaker of these solutions, the liquid increased its concentration to some extent during the experiment, as the vessels containing it were not covered, and evaporation took place.

water, and roughly dried by pressing between cloths. After this no further exudation was produced.

As the experiments described above were not numerous, it is desirable that others should be carried out. These might include the treatment of twigs collected earlier in the year than September. The addition of a poison to the solution of calcium chloride may also be recommended, as it was noticed that leaf-boring insects, which were present in some of the specimens, continued their burrows for a considerable time after the treatment with calcium chloride had been completed.

The three following experiments in treating beech twigs with calcium chloride were also made:—(1) The end of a twig was placed in a solution of calcium chloride in 50 per cent. spirit and left for some days, just as in the experiments with the watery solution; (2) a small specimen was kept immersed in a watery solution of calcium chloride for several days; (3) a specimen was boiled for a few minutes in the watery solution. These experiments did not give any satisfactory or even promising results, and were not repeated.

In addition to beech, twigs of hornbeam, bay-laurel, and elm were placed with their cut ends in a solution of calcium chloride. Fairly good preservation was obtained in the case of hornbeam, though the leaves assumed a rather dingy appearance, but the method appears unsuitable for bay and elm.

A few experiments were made in dyeing leaves of beech and hornbeam previously preserved by treatment with calcium chloride. The stain was applied by immersion in a watery solution of the dye, after which the leaves were rinsed in water. It was found, however, that if the leaves were left for an hour or two in the stain they were liable to curl on drying, probably owing to loss of calcium chloride. Hence, if rapid staining cannot be carried out, experiments might be made on the feasibility of dyeing specimens first and then treating them with calcium chloride.

XXV.—DIAGNOSES AFRICANAE: LXX.

1611. **Olax insculpta,** *Hutchinson ex E. G. Baker* in Cat. Pl. Talb. Nigeria, 124, nomen [Olacaceae-Olaceae]; affinis *O. Mannii,* Oliv., sed foliis latioribus plerumque ovato-orbicularibus nervis lateralibus profunde insculptis, floribus majoribus differt.

Frutex glaber; ramuli flexuosi, parce foliati, graciles, profunde sulcati. *Folia* ovato-orbicularia vel ovato-elliptica, basi leviter obliqua et brevissime cuneata, apice sensim acuminata, breviter acute mucronata, 10-15 cm. longa, 6-10 cm. lata, tenuiter chartacea, integra, viridia, basi trinervia; costa infra valde conspicua, basi circiter 1·5 mm. lata, apicem versus angustata: nervi laterales utrinsecus 5-6, supra profunde impressa, infra prominentes, intra marginem circiter 1 cm. conspicue juncti, juncturis arcuatis prominentibus; venae paucae, plerumque inconspicuae; petioli usque ad 5 mm. longi.

infra verrucosi. *Racemi* axillares, brevissimi, flexuosi, 5-6-flori; bracteae anguste lanceolatae, acute acuminatae, 1 mm. longae; pedicelli 1·5-2 mm. longi. *Alabastra* crasse elevata, 6 mm. longa. *Calyx* subcupularis, 0·5 mm. altus, marginem versus submembranaceus, leviter undulatus vel denticulatus. *Petala* 5, linearia, apice cucullata, 7 mm. longa, 1 mm. lata, carnosa. *Stamina* perfecta 3, imperfecta 8; filamenta crassa, petalis paulo breviora; antherae ellipsoideae, 1·5 mm. longae. *Discus* crassus, annularis. *Ovarium* ovoideum, basi triloculare; stylus 2 mm. longus.

Tropical Africa. Southern Nigeria: Oban district, *Talbot* 1334.

1612. **Pteleopsis obovata,** *Hutchinson* [Combretaceae-Combreteae]; species foliis late obovatis distincta.

Arbor 10-20 m. alta; ramuli cinerei, cortice glabrescente lenticellato, juniores rufo-pubescentes. *Folia* pauca, obovata, apice emarginata, basi breviter cuneata, 1·5-2·5 cm. longa, 1·2-1·7 cm. lata, tenuiter chartacea, infra delicate reticulata, utrinque costa rufo-pubescente excepta glabra; nervi laterales utrinsecus circiter 7, infra distincti; petioli 1-1·5 mm. longi, rufo-pubescentes. *Racemi* terminales, capituliformes; pedunculi 0·5-1 cm. longi, rufo-pubescentes; bracteae lineares 1·5-2 mm. longae, longe ciliatae; pedicelli gracillimi, usque ad 0·7 cm. longi, glabri. *Receptacula* cupularia, 1 mm. longa, extra glabra. *Calycis* lobi triangulares, fere 1 mm. longi, intra pubescentes. *Petala* spatulata, unguiculata, 1·5 mm. longa, 1 mm. lata. *Stamina* 10; filamenta 2·5 mm. longa, glabra; antherae late ovoideae, 0·5 mm. longae. *Ovarium* elongatum, glabrum. *Fructus* elliptico-oblanceolatus, complanatus, alatus, glaber, 2-2·5 cm. longus.

Tropical Africa. Portuguese East Africa: Msalu River, timber tree 50-60 ft. high. *Allen* 72; Msalu River Mouth, Jan. 12. *Allen* 156; Madanda forest, Oct., shrub or small tree, vernacular *Moaza*. *Dawe* 449.

1613. **Phyllanthus leonensis,** *Hutchinson* [Euphorbiaceae-Phyllantheae]; affinis *P. alpestri*, Beille, sed ramis glabris, foliis lanceolatis plerumque longioribus differt.

Caules ut videtur e rhizomate orti, simplices vel superne parce ramosi, erecti, glabri, basin versus circiter 2·5 mm. crassi. *Folia* lanceolata, apice obtusa, basi cordata, 1·5-3 cm. longa, 0·6-1·2 cm. lata, chartacea, glabra, marginibus incrassatis recurvatis; nervi laterales utrinsecus 5-6, infra conspicui; petioli nigri, verrucosi, 1·5 mm. longi; stipulae deciduae, ovato-triangulares, acutae, 1-1·25 mm. longae, membranaceae. *Flores* dioici. ♂ fasciculati. ♀ solitarii. *Pedicelli* ♂ capillares, usque ad 4 mm. longi, glabri; sepala 6, subaequalia, obovata, 1 mm. longa, membranacea, glabra; disci glandulae fere contiguae, rotundatae, laeves: stamina 3; filamenta libera, 0·75 mm. longa; antherae ellipsoideae, loculis divergentibus. *Pedicelli* ♀ nutantes, 0·5-1·3 cm. longi, sub calyce incrassati;

sepala 6, ovata vel elliptica, obtusa, subcarnosa, 1·25-1·5 mm. longa, 0·75 mm. lata, glabra; discus crenato-undulatus; ovarium 6-lobatum; styli brevissimi, recurvati, bifidi. *Capsula* depressa, 6·5 mm. diametro, 6-lobulata, obscure reticulata, stylorum vestigiis coronata. *Semina* triquetra, laevia, pallide straminea.

Tropical Africa. Sierra Leone: Sendugu, June 22, 1914, *N. W. Thomas* 580.

1614. **Agrostistachys ugandensis,** *Hutchinson* [Euphorbiaceae-Crotoneae]; affinis *A. africanae*, Muell. Arg., sed receptaculis ♂ glabris (nec villoso-pubescentibus), styli ramis e basi reflexis et breviter 2-lobatis (nec profunde partitis) differt.

Arbor parva (dioica?); ramuli floriferi circiter 1 cm. crassi, teretes, glabri. *Folia* magna, usque ad 4 dm. (plerumque circiter 2·5 dm.) longa, 0·8-2 dm. lata, repando-denticulata vel subintegra, chartacea, glabra, infra delicate reticulata; nervi laterales utrinsecus 16-20, a costa sub angulo latissimo abeuntes, marginem versus arcuati et evanidi, utrinque prominentes; nervi tertiarii numerosi, cum lateralibus angulo recto formantes, paralleli, tenues; petioli 2-3 cm. longi; stipulae caducae, terminales, lineares, acutae, circiter 2 cm. longae, glabrae. *Flores* axillares, ♂ dense fasiculati vel interdum subracemosi, ♀ in racemos axillares solitarios vel subsolitarios usque ad 6 cm. longos dispositi. *Flores* ♂ numerosi; pedicelli 0·6-1 cm. longi, 2 mm. supra basin articulati et pubescentes, superne glabri; bracteae 3, exteriore ceteras involventes late ovato-orbiculare integro coriaceo circiter 5 mm. longo et 4 mm. lato superne ciliolato, duabus interioribus oppositis cymbiformibus apice cucullatis et ciliolatis marginibus membranaceis; sepala 5, ovato-elliptica, 5-6 mm. longa, chartacea, apices versus extra breviter pubescentia; petala 5, sepalis fere aequilonga, oblongo-elliptica, glabra; discus glaber, crassus, lobulatus, inter lobulos staminibus numerosis insertis; filamenta circiter 5 mm. longa, antheris superne verrucosis; ovarium rudimentarium nullum. *Flores* ♀: bracteae pedicelli et perianthium ut in floribus ♂; discus hypogynus crassus, lobulatus, inter lobulos staminodiis subulatis insertis; ovarium tomentosum; styli e basi patuli, bilobulati, lobis acutis 1·25 mm. longis. *Fructus* non visus.

Tropical Africa. Uganda: Namalala forest, July 1913, ♂ fls., *Fyffe* 19; ♀ fls., vernacular *Munyabake*, *Fyffe* 64.

The discovery of a species of this genus in Uganda is very interesting in that it forms a connecting link in its geographical distribution—on the one hand between the West Coast of Africa (islands of St. Thomas and Fernando Po)—where *A. africana* occurs, and with India and the Malay Archipelago, where there are several species. Those who accept the classification of Pax in Engler's Pflanzenreich would include this new species in his genus *Pseudoagrostistachys*, founded on *A. africana*. Both these species differ from the Indian and Malayan in the absence of a rudimentary ovary from the male flowers.

1615. **Sapium Dalzielii,** *Hutchinson* [Euphorbiaceae-Crotoneae]; affinis *S. faradianense,* Pax, sed foliis multo angustioribus linearibus vel lineari-lanceolatis obscure denticulatis differt.

Caules erecti, e rhizomate lignoso gracile orti, e basi ad apicem foliati, subsimplices, graciles, sulcati, glabri. *Folia* linearia vel lineari-lanceolata, apice acuta, basi obtuse rotundata, 1·5-4 cm. longa, 0·3-0·8 cm. lata, uninervia, rigide chartacea, glabra, margine cartilagineo-incrassato minute denticulato basi utrinque 2-3-glanduloso; petioli 1-2 mm. longi, glabri. *Inflorescentiae* terminales, circiter 3-5 cm. longae, superne floribus masculis laxe dispositis, basin versus floribus foeminibus 1-2 instructae, utriusque sexibus brevissime pedicellatis, ad bracteis solitariis; bracteae trilobatae, lobo centrali lanceolato-triangulari acuto 1 mm. longo, lobis lateralibus crassis carnosis glanduliformibus glabris supra concavis 1·25 mm. latis suborbicularibus. *Flores* ♂: Calyx profunde 3-lobatus, lobis ovato-triangularibus minute denticulatis glabris. *Stamina* 3; filamenta demum 0·75 mm. longa. *Flores* ♀ pedicello crasso brevissimo; calyx 3-partitus, segmentis late ovato-triangularibus dentatis vel dentato-serratis acute apiculatis. *Ovarium* glabrum; styli 3, recurvati, 1·5 mm. longi. *Capsula* delapsa tantum visa 0·8 cm. longa, minute verrucosa. *Semina* late oblongo-ellipsoidea, 5 mm. longa, 4 mm. lata, pallide straminea.

Tropical Africa. Northern Nigeria: Katsina Allah, June, *Dalziel* 749.

1616. **Myrica arborea,** *Hutchinson* [Myricaceae]; affinis *M.* Kandtianae, Engl., sed foliis basi truncatis et inaequalibus, inflorescentiis unisexualibus differt.

Arbor 6-9 m. alta; rami satis robusti, circiter 5 mm. crassi, sulcati, arcte puberuli et glandulosi; ramuli juniores dense foliati, fere tomentelli. *Folia* oblonga vel oblongo-lanceolata, ad apicem breviter mucronatum rotundata, basi plerumque truncata et inaequalia, 5-9 cm. longa, 1·2-3·2 cm. lata, rigide chartacea vel subcoriacea, plerumque dentata vel serrulata, rarius subintegra, utrinque (infra dense) glandulosa, ceterum glabra; costa infra prominens; nervi laterales utrinsecus 12-16, a costa fere subangulo 90° divergentes, marginem versus plerumque distincte bifurcati, tenues, utrinque prominentes; venae ultimae vix evolutae; petioli 4-6 mm. longi, glandulosi et breviter pubescentes. *Flores* monoici. *Spicae* ♂ axillares, plerumque petiolis duplo longiores vel in ramulos efoliatos longos racemosim dispositae; rachis sericeo-tomentella; bracteae latissime-obovatae, fere 2 mm. longae, submembranaceae, ciliatae, extra glandulosae et pubescentes; stamina circiter 6; antherae parce pubescentes. *Spicae* ♀ ad basin ramulorum juniorum dispositae vel axillares et petiolis duplo longiores; bracteae late triangulares, circiter 2 mm. longae, submembranaceae, extra glandulosae et leviter pubescentes, ciliatae; ovarium et squamae hypogynae pubescentes et glandulosae; styli complanati, lati, crebre verrucosi.—*M. salicifolia,* A.

Cheval. Monogr. Myric. 140, partim; Engl. in Mildbr. Wiss. Ergebn. Deutsch. Zent.-Afr. Exped. 178, partim, non Hochst.

Tropical Africa. Upper Guinea: Cameroons; Cameroon Mountain, 2300-2620 m., *Mann* 1203; 2185. Borders of forests on the Mannsquelle, *Mildbraed* 3409. Buea, *Deistel* 179.

1617. **Salix Hutchinsii,** *Skan* [Salicaceae]; *S. capensi,* Thunb., valde affinis, sed capsula angustiore in stylum fere 1 mm. longum gradatim attenuata et glandulis disci pedicello subaequilongis differt.

Ramuli juniores primo parcissime pubescentes, cito glabrescentes, purpureo-brunnei. *Folia* petiolata, anguste lanceolata vel oblanceolata, apice acuta vel acuminata, basi attenuata, integra vel interdum minute serrulata, 2-3·5 cm. longa, 6-10 mm. lata, tenuia, glabra, supra viridia, infra conspicue glauca; petiolus 2-5 mm. longus, glaber vel parcissime pubescens; stipulae minutae. *Amenta* ♂ desunt. *Amenta* ♀ 1-3 cm. longa, laxa, pedunculos breves foliosos terminantia; rhachis griseo-villosa. *Bracteae* late ovatae, obtusae vel subacutae, 2 mm. longae, basi fere 2 mm. latae, membranaceae, dense villosae praesertim ad margines, apice extra glabrescentes, cito deciduae. *Glandulae disci* 1 vel 2, posticae vel laterales, magnae, carnosae, pedicellum dimidio cingentes eique aequi-vel subaequilongae. *Pedicellus* circiter 1 mm. longus, crassus, glaber. *Ovarium* anguste ovoideum, 3-3·5 mm. longum, glabrum, in stylum distinctum fere 1 mm. longum gradatim attenuatum; stigma breviter crasseque 2-lobum. *Capsula* (immatura) anguste ovoideo-ellipsoidea, 4-5 mm. longa, 2-2·5 mm. lata.

Tropical Africa. British East Africa: banks of the Guaso Nyiro River, *Hutchins;* at 1830-1980 m., *Battiscombe* 29.

1618. **Salix Murielii,** *Skan* [Salicaceae]; *S. nigericae,* Skan, affinis, sed foliis saepe latioribus etiam adultis majus griseo-pubescentibus, stylo nullo differt.

Ramuli teretes, juniores dense griseo-villosi, demum glabri et brunnei. *Folia* ovato-lanceolata vel late lanceolata, apice acuta vel acuminata, basi rotundata vel leviter cuneata vel interdum paulum cordata, integra, 3·5-7 cm. longa, 1·3-2·5 cm. lata, utrinque etiam adulta plus minusve dense griseo-sericea; petiolus 2-7 mm. longus, dense breviterque griseo-villosus; stipulae oblique ovatae, 4-9 mm. longae, plus minusve glanduloso-denticulatae, interdum supra papillis glandulosis instructae, interdum minutae vel 0. *Amenta* foliis coaetanea. *Amenta* ♂ cylindrica, 2·5-7 cm. longa, 7-8 mm. crassa, densiflora; rhachis villosa. *Pedunculus* ad 1·5 cm. longus, villosus, folia plura breviter petiolata obovata vel elliptica 1-1·5 cm. longa et 4-6 mm. lata apice rotundata et apiculata vel acuta ferens. *Bracteae* ellipticae, obovatae vel ovatae, 2-3 mm. longae, 1·5-2 mm. latae, apice obtusae vel rotundatae, pilis albis lanatis dense tectae. *Glandulae disci* fere ad 1 mm. longae, latae et complanatae, integrae, dentatae vel profunde lobatae. *Stamina* 6-12; filamenta inferne dense lanata. *Amenta* ♀ fructifera 3·5-5 cm.

longa; rhachis villosa. *Pedunculus* 1·5-3 cm. longus, folia plura elliptico-lanceolata apiculata ad 3 cm. longa et 1·5 cm. lata ferens. *Bracteae* ellipticae, 3 mm. longae, 1·5 mm. latae, obtusae, dense villosae, cito deciduae. *Glandulae disci* poculum irregulare dentatum vel lobatum quadranti vel dimidio pedicelli quem cingit aequilongum formantes. *Pedicellus* 1-1·5 mm. longus, villosus. *Capsula* late ovoidea, 4-6 mm. longa, 2·5-3·75 mm. lata, glabra vel interdum sat dense villosa; stylus nullus; stigmata parva, leviter lobata.—*S. Safsaf*, Forsk., var. *hirta*, Anders. in Vet.-Akad. Handl. Stockh. vol. vi. (1867) no. 1, p. 12, and in DC. Prodr. vol. xvi. pars ii. p. 197.

Tropical Africa. Nile Land: without precise locality, *Sabbatier*. Nubia; near Khartoum, *Schweinfurth* 866; between Berber and Khartoum, *Schweinfurth* 611. Sennar; common on the Blue Nile, *Muriel* S18, S19; north of the mouth of the River Dinder, *Brown*.

1619. **Salix nigerica,** *Skan* [Salicaceae]; *S. Chevalieri,* Seemen, proxima, sed foliis haud vel tantum leviter reticulatis et capsula breviore late ovoidea distinguenda.

Ramuli teretes, juniores sericeo-pubescentes, demum rubro-brunnei et glabri. *Folia* lanceolata, apice acuta vel acuminata, basi rotundata vel cuneata, remote minuteque serrulata vel integra, 3·5-7 cm. longa, 7-18 mm. lata, juniora plus minusve sericeo-pubescentia, demum glabra et coriacea; petiolus 2-5 mm. longus, puberulus vel glaber; stipulae desunt. *Amenta* foliis coaetanea; rhachis dense villosa. *Pedunculus* 1-2 cm. longus, villosus, folia pauca elliptico-lanceolata breviter petiolata apice rotundata vel apiculata 6-18 mm. longa 3-8 mm. lata plus minusve sericeo-pubescentia ferens. *Amenta* ♂ cylindrica, 1-3·5 cm. longa, 5-6 mm. lata, densiflora. *Bracteae* sub-orbiculares vel obovatae, fere 2 mm. longae, 1·5 mm. latae, apice rotundatae, villosae. *Glandulae disci* anticae, subcylindricae, fere ad 1 mm. longae. *Stamina* ad 11 vel plura; filamenta inferne dense villosa. *Amenta* ♀ fructifera ad 3 cm. longa. *Bractae* eis amentorum ♂ simillimae, cito deciduae. *Glandulae disci* poculum lobatum pedicellum cingens eique fere aequilongum formantes. *Pedicillus* vix 1 mm. longus, villosus. *Capsula* late ovoidea, 5-6 mm. longa, 3-3·5 mm. lata, minute lepidota, interdum parce sericeo-pubescens; stylus fere ·5 mm. longus; stigmata 2-lobata.

Tropical Africa. Northern Nigeria: Katagum District; on banks of streams, *Dalziel* 220. Lake Chad to Bornu, *Talbot* 1493.

Dalziel's no. 199, from the banks of the Benue River at Yola, has male catkins only, and these are more slender than those of his no. 220 and have narrower sparingly woolly or nearly glabrous bracts, while the flowers have only 5 to 8 stamens. The leaves present on the short catkin-bearing branchlets are narrower and longer. It is possibly a distinct species, but the material is inadequate for a complete description. Its Hausa name is "ba ruana."

1620. **Salix Schweinfurthii,** *Skan* [Salicaceae]; *S. Murielii,* Skan, proxima, sed foliis oblongo-lanceolatis longe acuminatis ad 12 cm. longis, amentis fructiferis ad 6 cm. longis, capsula distincte rostrata differt.

Ramuli primo dense griseo-tomentosi, denum brunnei et glabri. *Folia* petiolata, oblongo-lanceolata, longe acuminata, basi rotundata, serrulata, ad 12 cm. longa, 2·5-4 cm. lata, primo utrinque dense villosa, demum glabrescentia, sat tenuia; costa conspicua, supra plana, infra elevata; nervi laterales numerosi, conspicui sed tenues; petiolus 8-14 mm. longus, plus minusve villosus vel glabrescens; stipulae semicordatae, rotundatae vel acutae, 4-16 mm. longae, glanduloso-denticulatae et interdum glandulis prominentibus ad ambas superficies praeditae. *Amenta* ♂ desunt. *Amenta* ♀ fructifera pedunculata, 2·5-6 cm. longa; rhachis villosa. *Pedunculus* villosus, 1-2·5 cm. longus, folia pauca lanceolata 1·5-3·5 cm. longa et 4-12 mm. lata ferens. *Bracteae* desunt. *Glandulae disci* ·5-·75 mm. longae, poculum irregulariter lobatum formantes. *Pedicellus* fere 2 mm. longus, glaber. *Capsula* ovoidea, supra medium in rostrum contracta, 4-5 mm. longa, circiter medium 2·5-2·75 mm. lata, glabra; stigmata subsessilia, brevissime 2-lobata.

Tropical Africa. Nubia: Khartoum, *Schweinfurth* 879. Kordofan, *Kotschy* 439.

Kotschy's no. 436, also from Kordofan, probably belongs to this species, but differs in having much smaller leaves. Like his no. 439 it bears no catkins.

Solms (in Schweinf. Beitr. Fl. Aethiop. p. 187) mentioned under the name of *Salix nilicola* a willow with long acute toothed leaves and very long catkins, of which specimens were collected by Ehrenberg in Dongola. It is possible that it is the same as *S. Schweinfurthii.*

XXVI.—MISCELLANEOUS NOTES.

Woody Vegetation and the Winter of 1916-17.—Looking over the collections of trees and shrubs at Kew, with recollections of last winter still vividly in mind—its seemingly interminable character and the severity of the cold on several occasions—the predominant feeling is one of surprise that so little real or permanent damage was done. A long series of mild or moderate winters had encouraged venturesomeness on the part of the planter, and in many gardens plants have been put in the open ground which could only be expected to collapse when the first real test came. The Eucalyptuses are examples; and after last winter's experiences the only species that can at present be called really hardy at Kew are *E. Gunnii* (the Whittingehame form) and *E. vernicosa.* All the others were killed. Many species of Cistus, too, could only be regarded as existing in our grounds on sufferance. When the last snows of April went and spring had really come, we found that five sorts had survived. *C. cyprius* and *C. laurifolius* were scarcely damaged; of *C.*

corbariensis perhaps half had succumbed; and of *C. salvifolius* and *C. Loreti* sufficient living growth remained to preserve them for the collection.

But, on the whole, by August the damage is seen to be surprisingly small. The number of plants killed outright is not large, and most of those which were badly scarred four months ago have had their wounds concealed by new growths. At the present time (August) the collection of bamboos looks better and more luxuriant than it has done for some years, thanks of course to the abundant rainfall, but in May last these plants made the most depressing group in Kew. Only one species, *Arundinaria anceps*, was cut back to ground level.

It is a curious fact that European vegetation has shown ill effects from the winter almost more than that of any other of the great areas that supply our hardy trees and shrubs. In many places, common gorse has been killed to the ground. At Kew, *Anthyllis Hermanniae* was swept out except under shelter, although it had survived all the winters since 1895. Most of the plants of rosemary were killed and very few *Erica australis* survived. That species, however, we have always regarded as about the most tender of European heaths in cultivation. *Erica arborea*, *E. lusitanica* and *E. Veitchii*, all somewhat hardier than *E. australis*, suffered injury, especially *E. Veitchii*, of which most had to be dug up. Large breadths of *E. mediterranea* are grown at Kew and they were badly hit where the plants had become crowded and drawn up; but sturdy well-exposed plants came through with little injury. Of the Portuguese form of *Erica ciliaris* (*Maweana*) a large proportion died. Many old plants of *Daboecia polifolia* were irretrievably injured but young ones have recovered. *Arbutus Unedo* and *A. hybrida* were badly cut where the trees were fully exposed to the north-east. Our stock of *Cytisus albus* was very much damaged, and in connection with the same species it was curious to find that several seedlings of *C. Dallimorei*—a hybrid between *C. albus* and *C. Andreanus*—were killed outright, although four or five years old.

Whilst common gorse was so severely hit, *Ulex Gallii*, a species confined in this country to the south-western counties, and generally regarded as less hardy, was not affected. On walls, myrtles and the olive were injured, but that was only to be expected.

Seeing what happened to common gorse, it is curious to find the reputedly tender *Magnolia Campbellii* quite untouched and making splendid growth this summer. The same can also be said of another inhabitant of the Himalaya with a similar reputation, viz. *Buddleia Colvilei*, which, growing without protection out of doors, has flowered this summer. The new Chinese Magnolias showed no ill effects nor did the various members of such interesting genera as *Meliosma*, *Tapiscia*, *Styrax*, *Emmenopterys*, *Stewartia*, *Dipelta*, *Kolkwitzia*, *Evodia*, *Sargentodoxa* (near a wall), *Sinowilsonia*, *Fortunearia*, *Poliothyrsis* and *Sinofranchetia*. Nor were the young conifers of Wilson's and Forrest's introduction in anyway hurt. The only

barberry to show ill effects was *B. atrocarpa* (the *B. levis* of gardens), but it has quite recovered.

Some of the newer Rhododendrons of Forrest's introduction were killed, amongst them *R. bullatum* and a few unnamed species, but on the whole the Chinese species came through remarkably well. Except that the flower buds of many were destroyed and some of the more sappy growths cut back, they were so little affected that by July the great majority presented a normal appearance.

Much of the damage done to Ericaceae at Kew was caused by an exceedingly bitter north-east wind which swept across the place without intermission for about a week near the end of January. During this period of incessant wind the temperature rose only once a single degree above freezing point. Probably this black week did more harm than all the frosts, which can scarcely be regarded as of extraordinary severity. The lowest temperatures were recorded on Feb. 7, 8, and 9 when the minimum thermometer registered 22, 20, and 17 degrees of frost respectively.

One thing greatly in favour of hardy vegetation was the absence of the soft mild periods so characteristic of our winter seasons. In 1908-9 the mischief done was much greater, and it was due to the alternation of sharp frost and warm moist periods, the latter setting up growth only to be destroyed by a cold time following. Another thing to which has been due the healthy aspect of trees and shrubs generally since early summer was the absence of any late frosts. Growth was very late in starting and many plants were a month or six weeks behind their normal time in flowering. The high blossoming time of trees and shrubs consequently was a very short one, but, so far as leafy growth is concerned, once started they were never checked. To this also is due the fruiting of many trees and shrubs that very rarely reach that condition, owing to the destruction of the young fruits by late frosts. Kew lacked much of its characteristic charm during March and April, and one missed the familiar early flowers which in ordinary years belong to those months. But, on the whole, and in spite of the long cold winter, the year 1917 can be regarded as one very favourable to woody vegetation. W. J. B.

Zapupe.—Zapupe fibre came into prominence a little more than a decade ago, when in 1907 there were over 5,000,000 plants in various stages of growth in the State of Vera Cruz (see *K.B.* 1907, p. 397). Except for the botanical identity all the important information has been given in previous issues of the Bulletin (see 1906, p. 190; 1907, pp. 396-400; 1908, p. 268).

The three following cultivated species have been defined by Trelease, and good descriptions of the plants are given by Trelease and Berger:—

Agave Zapupe, *Trelease* in Trans. Acad. Sci. St. Louis, xviii. (1909), p. 32. t. i. (spines), t. ii. (panicle and bulbils); Berger, Die Agaven (1915), p. 237.

Blue Zapupe, Zapupe Azul, Zapupe de Estopier or Zapupe de San Bernardo of Tuxpan, Vera Cruz.

A. Lespinassei, *Trelease*, l.c. p. 33, t. i. (spines), t. iii. f. i. (parts of leaf); Berger, l.c. p. 256.

Zapupe de Tepezintla or Zapupe de Vincent of Juana, Ramirez and Tuxpan.

A. Deweyana, *Trelease*, l.c. p. 35, t. i. (spines), t. vi. (photograph of old panicles); Berger, l.c. p. 257.

The cultivated green Zapupe, Zapupe de Huasteca, Zapupe de Tantoyuca or Zapupe Verde of the region between Tampico and Vera Cruz.

None of these are known in the wild state; but Trelease distinguishes a fourth species, *A. aboriginum*, known in the region between Tampico and Vera Cruz as the wild Zapupe, Zapupe Cimarron, Zapupe silvestre, or Zapupe de Sierra Chontla; and this is said to be sometimes cultivated.

The herbarium material at Kew consists of spines only, from the Missouri Botanic Gardens. Flowers with the exception of those of *A. Zapupe*, do not appear to have been described by anyone, and the species have been distinguished chiefly on the characters of the leaves and spines. The latter are so well marked as to prevent any one species being mistaken for the other, and in general the plants, allowing for the slightly narrower leaves with the prickles on the edges, closely resemble Sisal Hemp (*Agave sisalana*).

In 1909 it was reported that the planting and cultivation of Zapupe continued to attract much attention, and several plantations three years old were cleaning and exporting fibre.[1] By 1910 several companies had been formed for the cultivation, in addition to the planting done by private individuals.[2] In 1911 a Belgian Syndicate made arraugements for the development of this fibre plant in the Vera Cruz district.[3] Finally, however, it was reported that in 1913 the cultivation had ceased and no fibre had been exported during the year.[4]

Small plants of *A. Zapupe* and *A. Deweyana* are in the collection of living plants at Kew.

A sample of Zapupe fibre (species indefinite) in the Museum, originally from Mexico, was valued in London, 1913, at £30 to £32 per ton, with Sisal Hemp in the same year realising up to £35 per ton. The latter fibre it may be of interest to note is quoted (June, 1917) at £80 per ton, nominal value.

It would seem to be advisable therefore for those Colonies where the conditions are suitable for *Agave* cultivation to confine their attention to the better known Sisal Hemp, over which, notwithstanding early recommendations, Zapupe apparently possesses no advantage. J. H. H.

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[1] Dip. and Cons. Rep. 4453, 1910, p. 5, Tampico.
[2] l.c. 4665, 1911, p. 9, Vera Cruz.
[3] l.c. 4873, 1912, p. 9.
[4] l.c. 5365, 1914, p. 15, Tuxpan, Vera Cruz.

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ROYAL BOTANIC GARDENS, KEW.

BULLETIN

OF

MISCELLANEOUS INFORMATION.

[Nos. 7 & 8] [1917

XXVII.—A LIST OF ECONOMIC PLANTS NATIVE OR SUITABLE FOR CULTIVATION IN THE BRITISH EMPIRE.

The editor of the *Kew Bulletin* has very kindly asked me to write a few words of introduction to the List of Economic Plants, which comprises the present double number of the *Bulletin*, with a view to explaining its origin and object.

In response to the invitation of the Council of the British Association the Sectional Committees met early in last year to consider what could be done in their respective Sections to meet problems which would arise after the war. Among the suggestions which were considered by the Committee of Section K (Botany), in a meeting at which I had the honour to preside, was one embracing the more extended and thorough study of those plants of economic value which are native or capable of being cultivated in Great Britain or other parts of the Empire. It was recognised that economic plants and their uses afforded opportunity for botanical investigation from many points of view and in this connection a list of the plants classified according to their uses was a desideratum. Sir David Prain, who took part in the discussion, kindly undertook to have such a list prepared, from the sources available at Kew, for the information of the members of the Committee. The list having been prepared, its great value and importance at once indicated that it should be made widely available for botanists and others interested in economic botany. The Director of the Royal Botanic Gardens was asked, and agreed, to publish it as a number of the *Kew Bulletin*, and it was suggested that an additional number of copies might be supplied to the British Association for distribution by the Botanical Committee. The Committee of Section K welcomed this suggestion, and its recommendation was accepted by the Council and General Committee. Owing to the temporary suspension of the *Bulletin* the publication of the List has been deferred until now.

The List is of great interest. It not only indicates the large number of plants which are already recognised as of practical economic use and capable of being grown or cultivated in

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different parts of our Empire, but is also full of suggestion for possibilities of development. The botanist who wishes to work at a problem which may yield results of economic value will find numerous hints in the following pages. There is ample opportunity for work on physiological, chemical, anatomical or taxonomic lines; and there are also problems which should interest the Mendelian. The remarkable differences in yield of the economic product in closely allied species, or in varieties and forms of one and the same species, or in plants of the same form when grown under different conditions of climate or soil, afford subjects for investigation. The systematist may do good service by monographic study of such groups, and by careful diagnosis of the species and varieties may enable the man in the field to discriminate the more valuable forms from those which are of less value for his purpose. There are many instances where the specific identity of the useful plant is unknown; the botanical collector may solve such problems, and also increase our knowledge of the habitat and range of distribution of useful plants, as well as add to their number. To the botanist who is willing to help on matters after the war by taking up work which directly or indirectly may be of economic value this Kew List indicates many paths of widely varying interest.

The List will also be useful for general reference. Botanists associated with various institutions frequently receive queries of an economic nature which are answered with some difficulty or only at the cost of a search through very scattered literature. Probably most of these queries could be easily answered at Kew, but it will be a saving of time and labour all round to have the information, now supplied by the List, ready to hand and thus to render available for workers at home and abroad an epitome of the knowledge which has been gathered together at one centre.

A. B. Rendle.

FATTY OILS.

In addition to extracted oil large quantities of Nuts and Kernels for the extraction of oil are imported. In 1913, unenumerated Oil Seeds and Kernels to the weight of 9,087 tons, valued at £172,861 were imported from Foreign Countries, and in the same year 41,165 tons of Oil Seeds and Kernels valued at £863,484 were imported from British Possessions. Copra was not included in these returns, the weight of Copra imported from Foreign Countries in 1913 being 6,154 tons, valued at £177,885. In the same year British Possessions supplied 24,714 tons of Copra valued at £718,822.

Coco-nut (*Cocos nucifera, L.*).

British.—India, Straits Settlements and Dependencies, Australia, New Zealand, British West Indian Islands, &c.

Foreign.—French Possessions in the Pacific, Philippine Islands, &c.

The dried meat of the nut (Copra) is imported from these countries and the oil extracted here. But in addition a large

quantity of refined and unrefined oil is imported. The imports of Copra are given above. The imports of Coco-nut Oil for 1913 were as follows:

FOREIGN—

	Cwts.		Value. £
Refined	537,939	...	1,296,619
Unrefined	435,227	...	939,128
BRITISH—			
Refined	8,803	...	19,627
Unrefined	187,574	...	403,341

The Foreign Countries principally concerned with the oil were:—

	Refined. Cwts.		Unrefined. Cwts.
Denmark	66,004	...	21,289
Germany	210,604	...	397,016
Belgium	53,675	...	6,370
France	194,556	...	9,610

The British Possessions chiefly interested were:—

	Refined. Cwts.		Unrefined. Cwts.
India	222	...	20,089
Ceylon	8,516	...	140,771
Australia	65	...	26,714

African Oil Palm (*Elaeis guineensis*, Jacq.).

BRITISH.—Sierra Leone, Gold Coast, Southern Nigeria, &c. FOREIGN.—Germany, German West Africa, French West Africa, Portuguese West Africa, Liberia, &c.

The Imports and Values of African Palm Oil (excluding kernels for crushing) for 1913 were as follows:—

Unrefined—British—

	Cwts.		£
Sierra Leone ...	37,212	...	54,057
Gold Coast ...	44,138	...	61,597
Southern Nigeria ...	1,325,964	...	1,931,707
Other British Possessions...	24,992	...	37,570
Total ...	1,432,306		£2,084,931

Refined—Colonial and British Possessions—

	Cwts.		£
British Possessions...	200	...	432

Unrefined—Foreign—

	Cwts.		£
Germany	91,854	...	186,234
German West Africa	15,002	...	22,116
French West Africa	12,088	...	17,803
Portuguese W. Africa	4,101	...	5,765
Liberia	3,132	...	4,398
Other Foreign Countries	3,702	...	5,595
Total ...	129,879		£241,911

Refined—Foreign—

	Cwts.		£
Germany	55,848	...	135,820
Other Foreign Countries	2,182	...	5,715
Total ...	58,030		£141,535

The African Oil Palm (*Elaeis guineensis*) is fully dealt with in the *Kew Bulletin* for 1909, p. 33 and p. 161. Descriptions of various varieties are given in the same work for 1914, p. 285.

Central American Oil Palm, Cohune Palm (*Attalea Cohune*, Mart.).

British.—British Honduras.

This Palm is very common in British Honduras. The kernels are rich in oil, but the nuts are not largely worked owing to the thick woody pericarp being difficult to remove cheaply without injuring the kernels.

Olive (*Olea europaea*, L.).

British.—Australia. Foreign.—France, Spain, Italy, Greece, Turkey, Algeria, Tunis, California, etc.

The imports of Olive Oil to the United Kingdom are almost entirely from Foreign Countries. In 1911 and again in 1912 one tun of refined Olive Oil was imported from British Possessions. In 1911 the value was £81 and in 1912 £73. In 1913 British Possessions supplied this country with £33 worth of oil.

The imports of Olive Oil from Foreign Countries in 1913 were as follows:—

	Tuns.		Value. £
Netherlands	255	...	10,462
France	303	...	13,988
Spain	732	...	35,289
Italy	395	...	16,459
Greece	292	...	12,355
Turkey and Crete ...	693	...	33,252
Other Foreign Countries	212	...	8,386
Total ...	2,882		£130,191

It is probable that important Olive Oil industries could be developed in South Africa, New Zealand and British East Africa as well as in Australia.

Castor Oil (*Ricinus communis*, L.).

British.—India (chiefly). Foreign.—Italy, United States of America, &c.

In 1913, 1,203,355 cwts. of seed valued at £709,061 were imported into the United Kingdom from British India. From foreign sources 1584 cwts. valued at £992 were received. Although few countries are enumerated in the Board of Trade Returns as sending seed or oil to the United Kingdom, the plant is widely grown in tropical and sub-tropical countries, the oil expressed from the seeds being in considerable demand for lubricating purposes, burning, leather dressing, and for medicine. From Foreign Countries 1067 tons of oil valued at £32,174 were received in 1913, and from British India 332 tons of oil valued at £9,701 were imported during the same year.

Linseed (*Linum usitatissimum, L.*).

British.—India, Canada, &c. Foreign.—Russia, Germany, Netherlands, Belgium, France, Turkey (European and Asiatic), Morocco, China, United States of America, Uruguay, Argentine Republic, &c.

Large quantities of seed and oil are imported. In addition a considerable quantity of cake manufactured from the residue of the seed after most of the oil has been extracted is imported for cattle food. The imports of seed and oil for 1913 are as follows:—

Seed from Foreign Countries.

	Quarters.	Value. £
Russia	99,247	228,167
Germany	9,652	21,952
Netherlands ...	13,587	39,949
Belgium	5,325	12,326
France	57	196
Turkey, European ...	1,826	4,667
Turkey, Asiatic ...	872	2,347
Morocco	1,538	4,292
China (not Hong Kong nor leased territory)	7,709	17,957
U.S. America ...	42,936	98,366
Uruguay	3,036	7,165
Argentine Republic	1,126,866	2,398,635
Other Foreign Countries ...	377	967
Total ...	1,313,028	£2,836,986

Seed from British Possessions.

	Quarters.	Value. £
British India ...	682,948	1,564,428
Canada	1,277,673	2,792,955
Other British Possessions ...	413	1,030
Total ...	1,961,034	£4,358,413

Linseed Oil Imports for 1913.

FOREIGN—

Pure Oil.	Tons.	Value. £
Germany	1,074	29,340
Netherlands ...	3,045	82,578
Belgium	2,381	61,428
U.S. America ...	5,325	135,464
Other Foreign Countries ...	37	1,205
France	—	27
Total ...	11,862	£310,042

	Tons.	Value. £
BRITISH	4	115

Impure Oil.	Tons.	Value. £
Germany	3	105
Netherlands... ...	13	284
Belgium	5	102
Other Foreign Countries ...	1	22
Total ...	22	£513

Soya Beans (*Glycine hispida*, Maxim.).

FOREIGN.—Manchuria, China, Japan.

Large quantities of Soya Beans have been imported into the British Isles during the last 8 years, chiefly into Liverpool and Hull. They are almost entirely from Foreign Countries and the oil extracted from them is used for soap making.

Imports for 1913—

	Tons.		Value. £
Russia	38,086	...	316,848
China (not Hong-kong or leased territories) ...	36,430	...	301,595
Japan, Formosa, &c.	1,929	...	17,240
Other Foreign Countries ...	2	...	21
Total ...	76,447		£635,704

Soya Beans imported from British Possessions in 1913.

Tons.		Value. £
5	... ...	43

It is likely that Soya Beans will prove to be a valuable crop in various British Colonies.

Cotton Seed (*Gossypium* spp.).

British.—India, Egypt,* Nigeria, Brit. East Africa, Uganda, West Indian Islands.

Foreign.—Turkey, U.S. America, Hayti, Brazil, Peru, &c.

The imports of Cotton Seed and Cotton Seed Oil for 1913 were as follows.

Cotton Seed from Foreign Countries.

	Tons.		Value. £
Russia	17,770	...	124,486
Germany	3,510	...	28,001
Portuguese Possessions in India ...	30,462	...	209,715
Turkey	26,639	...	171,877
Egypt	238,788	...	2,065,471
China (exclusive of Hongkong and leased territories)...	182	...	1,290
U.S. America ...	380	...	2,636
Hayti	1,860	...	14,138
San Domingo ...	132	...	967
Colombia	886	...	7,060
Peru	12,745	...	99,263
Brazil	47,629	...	326,369
Other Foreign Countries ...	3,234	...	21,439
Total ...	384,217		£3,072,712

* From 1915 Egypt appears under the heading British Possessions in the "Annual Statement of the Trade of the United Kingdom."

Cotton Seed from British Possessions.

	Tons.		Value. £
Southern Nigeria ...	5,360	...	32,002
British East Africa...	4,172	...	26,504
Uganda	5,142	...	39,305
British India ...	213,931	...	1,459,993
Other British Possessions	2,510	...	18,101
Total ...	231,115		£1,575,905

Cotton Seed Oil (unrefined) from Foreign Countries.

	Tons.		Value. £
China (exclusive of Hongkong and leased territories)...	654	...	18,163
U.S. America ...	405	...	13,331
Other Foreign Countries	2	...	50
Total ...	1,061		£31,544

Cotton Seed Oil (unrefined) from British Possessions.

	Tons.		Value. £
Total	9	...	204

Cotton Seed Oil (refined) from Foreign Countries.

	Tons.		Value. £
Netherlands ...	545	...	18,766
France	183	...	6,602
China (not Hongkong, &c.)	80	...	2,166
U.S. America ...	15,506	...	521,746
Other Foreign Countries	266	...	8,808
Total ...	16,580		£558,088

	Tons.		Value. £
From British Possessions	6	...	189

Rape Seed Oil (*Brassica campestris*, L. sub-sp. *Napus*, L.).

British.—India. Foreign.—Russia, Germany, Netherlands, Belgium, Japan, China.

Large quantities of seed for crushing and the extracted oil are imported annually. It is probable that a great deal more Rape seed could be produced in British Possessions.

Rape Seed imported from British India in 1913.

	Quarters.		Value. £
Total	96,497	...	221,231

Rape Seed imported from Foreign Countries in 1913.

	Quarters.		Value. £
Russia	116,440	...	194,617
Germany	3,430	...	8,239
Netherlands ...	1,868	...	7,311
Belgium	2,141	...	5,369
Japan, Formosa, &c.	11	...	30
China (exclusive of Hongkong, &c.).	32,880	...	69,866
Other Foreign Countries	12,293	...	25,062
Total ...	169,063		£310,494

Rape Seed Oil imported from Foreign Countries in 1913.

	Tons.		Value. £
Germany	1,539	...	47,707
Netherlands ...	903	...	29,118
Belgium	1,884	...	55,411
France	366	...	10,770
China (exclusive of Hongkong and leased territories)...	50	...	1,500
Japan, Formosa, &c.	2,786	...	75,791
Other Foreign Countries ...	71	...	2,259
Total ...	7,599		£222,556

The residue of the seeds of Cotton, Rape, Soya Bean, Linseed and various other seeds is made into cake for cattle food and large quantities are imported in addition to the seeds and oil.

Ground Nuts (*Arachis hypogaea, L.*).

British.—West Coast of Africa, Rhodesia, Sudan, Natal, Ceylon, Fiji, West Indian Islands, &c.

Foreign.—Most tropical countries.

The imports are not given separately in the Board of Trade Returns, but a large quantity is imported from the various

British Colonies in Africa. It appears to be certain that all British needs could be supplied from the Colonies. The oil was worth from £38 to £45 a ton in 1911. The residue of the seed after the extraction of the oil can be used for cattle food and for manure.

Gingelly, Sesamum Seed, Sim Sim (*Sesamum indicum*, L.).

British.—India, Abyssinia, Sudan, Nigeria, &c. Foreign.—Asia Minor, &c.

The seed is very rich in oil which is used for soap making and as a substitute for Olive oil. In 1915 the price of seed per ton in Liverpool was £15 to £15 10s. The plant is easily grown in most tropical and sub-tropical countries. Full particulars of this species are given in *Kew Bull.* Add. Ser. ix. part 3, p. 511.

Sunflower Seed Oil (*Helianthus annuus*, L.).

British.—India. Also being tried in British East Africa, Sudan and other countries. Foreign.—Russia, China, &c. A sample of seed grown in the Sudan and examined at the Imperial Institute in 1911 was found to contain 22 per cent. of the whole seed of oil. The kernels alone contained 47·9 per cent. of oil. The residue of the seed after the oil has been extracted makes a good cattle food and the seeds are a good food for poultry. The seed received from the Sudan in 1911 was valued in Hull at £8 per ton. The seed was not, however, of the best quality. Col. Rep. Misc. Ser. No. 88, p. 467.

Manduro (*Balanites Maughamii*, Sprague.).

Foreign.—Portuguese East Africa. Lebombo Mountains and the banks of the Umbeluzi River.

The nuts contain about 60 per cent. of clear oil similar to Olive oil, burning with a bright flame. *Kew Bull.* 1913, p. 131. Col. Rep., Misc. Ser., No. 88, p. 492.

Balanites aegyptiaca, Delile.

British.—Northern Nigeria, Sudan, Uganda.

An oil resembling Cotton-seed oil has been obtained from the kernels which it is suggested (Col. Rep. Misc. Ser. No. 88. p. 492), could be used for soap-making and would probably be worth about the same as refined Cotton-seed oil. It is sometimes called "Betu Oil."

Osteophloeum platyspermum, Warb.

Foreign.—South America.

The kernels supply about 55 per cent. of fat. *Kew Bull.*, 1914, p. 333.

Oiticica Seed (*Moquilea* sp.).

Foreign.—South America.

Attention has frequently been directed to this seed in correspondence with Kew. The seeds are said to contain 64 per cent. of oil.

Mafura or Mafureira (*Trichilia emetica*, Vahl.).

British.—East Africa.

These seeds are said to contain 60 per cent. of a fatty oil used in cookery, for soaps and candles, &c. The value of the seeds in England may be £8-£9 a ton. *Kew Bull.*, Add. Ser. ix. pt. 1. p. 146.

Niger Seed Oil, Inga or Ramtil Seed Oil (*Guizotia abyssinica*, Cass.).

British.—Tropical Africa, cultivated in India.

The oil has been suggested as a substitute for Linseed oil in soap-making. It is used as a condiment and for burning. The seeds are also used as food for cage birds.

Okoto Nut or Koma Nut Oil (*Pentadesma butyracea*, Sabine).

British.—West Africa. Foreign.—Belgian Congo.

The kernels contain an edible oil. Several samples of the seeds have been received recently for identification.

See Bull. Agric. Congo Belge. 1912. vol. 3, No. 3, p. 573.

Chinese Wood Oil, Tung Oil (*Aleurites* spp.).

Foreign.—China.

This oil, which is a natural drying oil, has poisonous properties and is used in paints, varnishes, linoleum, &c. An article on "The Wood-oil Trees of China and Japan" is given in the *Kew Bull.*, 1914, p. 1.

Emi, Emi-Ori, Shea Butter (*Butyrospermum Parkii*, Kotschy).

British.—West Africa.

The kernels yield about 50 per cent. of fat known as Shea Butter. It is used for soap and candle making and in the manufacture of vegetable butters. See *Kew Bull.* Add. Ser. ix. pt. 3, p. 410.

In the above notes most of the principal fatty oils are mentioned together with a few of the more uncommon kinds to which attention has been directed lately. There are, however, a large number of other kinds of fatty oils derived from seeds, such as Dilo Seed Oil (*Calophyllum Inophyllum*, L.); *Vateria indica*, L., India; Poppy Seed Oil (*Papaver somniferum*, L.), Asia Minor, Persia, Egypt, India; Tea Seed Oil (*Camellia Thea*, Link.), India; Butter Tree of India (*Bassia butyracea*, Roxb.), India; *Mimusops Djave*, Engl., Southern Nigeria; Argan Oil (*Argania Sideroxylon*, R. & S.); Cow Pea Oil (*Vigna Catiang*, Walp.); *Pongamia glabra*, Vent.

References to many kinds of oil and fats are to be found in the Colonial Report (Miscellaneous Series) No. 88, and in *Kew Bull.* Add. Ser. ix. Some of the newer kinds of oil seeds are dealt with in *Kew Bull.*, 1913, p. 127, p. 131.

ESSENTIAL OILS.

Bergamot Oil (*Citrus Aurantium*, L., var. *Bergamia*).

British.—Jamaica. Foreign.—Italy, Germany, Algeria, &c.

In 1915 the average price of this oil, which is obtained from the rind of the green fruit, was about 12/6 per lb. Most of the imports are from Foreign Countries, but the West Indian Islands could probably produce a considerable quantity of oil for home use.

For further particulars see *K.B.* Add. Ser. ix. Part i. p. 123.

Oil of Orange (*Citrus Aurantium*, L.).

Foreign.—Sicily, South of France.

The price of this oil, obtained from the flowers, ranged, in 1915, from 6/3 to 7/6 a lb.

See *K.B.* Add. Ser. ix. Part i. p. 123 for further particulars.

Oil of Neroli (*Citrus Aurantium*, L.).

Foreign.—Germany, S. France, S. Spain.

This oil is obtained from the flowers of the Orange. The price varied in 1915 from 5/6 to 12/- per lb.

See *K.B.* Add. Ser. ix. Part i. p. 123.

Oil of Petitgrain (*Citrus Aurantium*, L., var. *Bigaradia*).

Foreign.—Paraguay, S. France.

This Oil is produced from the young twigs, leaves and immature fruit of the Bitter Orange. The best oil is said to be imported from Paraguay. Price in 1915 12/- to 13/- per lb.

In *K.B.* Add. Ser. ix. Part i. p. 124 other particulars are given.

Oil of Lemon (*Citrus medica*, L., var. *Limonum*).

Foreign.—Sicily, Germany, S. France.

The oil is obtained from the rind of the fruit. The principal country of production is Sicily. The price per lb. in 1915 ranged from 3/9 to 6/-.

See *K.B.* Add. Ser. ix. Part i. p. 136.

Oil of Limes (*Citrus medica*, L., var. *acida*, Brand).

British.—West Indian Islands, chiefly Jamaica, Dominica and Monserrat.

The price of this oil, obtained by distillation from Lime Juice, ranged in 1915 from 6/6 to 9/- per lb. A certian amount of oil in 1913 was imported from Germany.

See *K.B.* Add. Ser. ix. Part i. p. 132, for further particulars.

Oil of Japanese Star Anise (*Illicium verum*, Hook. f.).

Foreign.—China.

The oil is obtained from the fruits of this plant. They are often imported into France and the oil extracted there. Reference to this oil is given in *K.B.* 1888 p. 173.

Aniseed Oil (*Pimpinella Anisum*, L.).

FOREIGN.—Germany, South Russia, &c.

The oil is obtained from the fruits.

Oil of Cloves (*Eugenia caryophyllata*, Thunb.).

BRITISH.—Malay States, Mauritius, Zanzibar, West Indies. &c.

The oil is distilled from the unopened flower buds, from the leaves and from the wood. That from the buds was valued in 1915 at 5/4 per lb. and that from the leaves at 3/9 to 4/3 per lb.

Clove Bark Oil (*Dicypellium caryophyllatum*, Nees) and perhaps other trees.

BRITISH.—British Guiana. FOREIGN.—French Guiana.

Oil is distilled from bark and wood in S. America and wood is imported into France for the extraction of the oil. The oil has a strong clove-like odour. It is probable that the wood of other trees belonging to Lauraceae may be used for the same purpose. Particulars about this oil are given in *K.B.* 1912 p. 242.

Bitter Almond Oil (*Prunus Amygdalus*, var. *amara*, Stokes).

FOREIGN.—South of France.

The price of Almond Oil rose in 1915 from 12/6 per lb. to 36/- per lb. Oil obtained from the kernels of Apricot seeds imported from Asia Minor is said to be used as a substitute for Oil of Bitter Almonds.

Birch Oil (*Betula alba*, L., and other spp.).

FOREIGN.—Russia, Siberia, Germany, Austria, N. America.

The oil is obtained from the bark.

Cajuput Oil (*Melaleuca Leucadendron*, L., var. *minor*).

FOREIGN.—Celebes, Bouro, Amboyna.

The oil is distilled from the leaves and is used for medicinal purposes. Much of the oil used in this country has been imported through the Netherlands. Recent prices have been from 4/9 to 6/- per 21 ozs. Some oil is imported from the United States of America.

Oil of Bay (*Pimenta acris*, Kostel).

BRITISH.—W. Indies.

This oil, obtained by distillation from the dried leaves, is an industry of considerable importance in the West Indies. The leaves are also exported to other countries for the extraction of oil. *P. acris* var. *citrifolia* is a lemon-scented variety resembling very nearly *P. acris* proper, but differs markedly from it in the odour of the essential oil and does not appear to be extracted on a commercial scale. This variety is valueless as a source of True Bay oil.

See *K.B.* Add. Ser. ix. Part ii. p. 346.

Ajowan Oil (*Carum copticum*, Bth.).

British.—India, Egypt. Foreign.—Persia, Afghanistan, &c.

The oil has stimulative and carminative properties and is obtained from the fruits. It is rich in Thymol, and as most of the Indian exports of Ajowan seeds went to Germany before the war and Thymol was obtained from Germany that substance has become scarce. By the end of 1914 the price of seed had risen from 6/6 to 21/6 per lb. The following new sources of Thymol have been suggested. *Cunila mariana*, *Monarda punctata*, *Mosla japonica*, *Ocimum gratissimum*, *Ocimum viride*, *Origanum floribundum*, *Origanum hirtum*, *Satureia Thymbra*, *Thymus vulgaris*. See Bulletin of the Imperial Institute, Vol. xii. pp. 601-602. In *K.B.* 1916, p. 88 further information is given.

Caraway Oil (*Carum Carvi*, L.).

British.—British Isles, India. Foreign.—Holland, Germany, Russia, &c.

The oil, obtained from the fruits, has been scarce during the last year or two, and prices have advanced from 6/- per lb. in January, 1915, to 9/- per lb. in December, 1915. The cultivation of this plant might be increased in the British Isles.

Ylang-Ylang Oil and Cananga Oil (*Cananga odorata*, Hk. f. & Thoms.).

Foreign.—Luzon, Java, Bourbon and Madagascar.

Ylang-Ylang Oil is obtained by distillation from the fresh flowers of *Cananga odorata* and Cananga Oil from dried flowers of the same tree. Much of the trade seems to have been conducted through Germany. As the tree is common in the Malay Peninsula the extraction of the oil might be carried on in British Colonies. The price of the oil is at present about 10/- per lb.

See *K.B.* 1906, p. 398, for further particulars.

Camphor Oil (*Cinnamomum Camphora*, Nees).

British.—Ceylon. Foreign.—Formosa, China, Japan.

To distiinguish this oil from other Camphor Oils it is often called Common or Laurel Camphor Oil. The oil is usually distilled from the wood, but sometimes from the leaves. It may be noted that for some years past the Camphor tree has been experimentally cultivated in many of our Colonies with varying results, for, although the trees have thriven, in many instances they have failed to yield Camphor and only "light" Camphor oils in small quantities. The evidence is apparently conclusive that from the botanical characters alone it is impossible to distinguish the difference between oil-yielding and non-oil-yielding trees.

In *K.B.* 1899, p. 57, and 1908, p. 88, other particulars are given.

Borneo Camphor Oil, Sumatra Camphor Oil (*Dryobalanops aromatica*, Gaertn.).

British.—Malay States.

Cinnamon Oil (*Cinnamomum zeylanicum*, Breyn).

British.—Ceylon.

Oil can be obtained from both the leaves and the bark. At the present time it is valued at 5d. to 6d. per lb.

Citronella Oil (*Andropogon Nardus*, L.).

British.—Ceylon, Singapore. Foreign.—Java.

The oil is obtained from the leaves. Ceylon oil was valued at from 1/6 to 1/7 per lb. in the autumn of 1915 and Java oil was worth from 3/- to 3/6 per lb. at the same time. For further particulars see *K.B.* 1906, p. 297.

Eucalyptus Oils (*Eucalyptus* spp.).

British.—Australia.

The oil is distilled from the fresh leaves. Although native of Australia the various species of *Eucalyptus* are cultivated in many countries, and the distillation of the oil is undertaken in California, S. Europe, India, Transvaal, &c. Of the numerous species used three of the most important are *E. Globulus*, Lab. (Blue Gum); *E. citriodora*, Hook. (Lemon-scented Gum); *E. amygdalina*, Lab. (Peppermint Tree). In the autumn of 1915 the oil of *E. Globulus* was valued at 1/9 to 2/- per lb. That of *E. amygdalina* was worth 1/- to 1/2 per lb., and oil of *E. citriodora* sold at 7/6 per lb. There might be a good future for the distillation of oil from various species of *Eucalyptus* in South Africa. For other information see *K.B.* Add Ser. ix. Part ii. p. 312.

Oil of Geranium (*Pelargonium* spp.).

Foreign.—France, Spain, Algeria, Germany.

This oil is obtained from the leaves of several South African species of Pelargonium, chiefly *P. Radula*, var. *odoratissimum*, Soland., and *P. capitatum*, Ait., cultivated for the purpose in S. France, Spain, Algeria and the Island of Réunion. The value of the oil in 1915 was Bourbon, 9/6 to 10/3 per lb.; Algerian, 12/- to 15/- per lb.; French, 30/- to 35/- per lb.

Ginger-grass Oil (*Andropogon Schoenanthus*, L.).

British.—India.

The oil, which is extracted from the leaves, was valued in 1915 at from 5/6 to 6/- per lb.

Further information is given in *K.B.* 1906, p. 297.

Lavender Oil (*Lavandula vera*, DC.).

British.—England. Foreign.—South of France.

The cultivation of Lavender for oil is undertaken in certain parts of Surrey, Hertfordshire and a few other places in England, but the business appears to be capable of development. English oil was worth from 58/- to 60/- per lb. in 1915, and French oil at the same time sold at 11/6 to 16/6 per lb.

Oil of Spike or Lavender Spike Oil (*Lavandula Spica*, Cav.).

FOREIGN.—Spain, S. France.

This oil is inferior in quality to ordinary Lavender oil, and realised from 2/6 to 4/6 per lb. in 1915.

Otto of Rose (*Rosa* spp.).

FOREIGN.—Bulgaria, S. France, Persia, &c.

The chief Rose grown for the production of oil is *Rosa damascena*, Miller, others being *R. gallica*, L., *R. centifolia*, L., and *R. moschata*, Hermm. The oil is obtained from the petals of newly-expanded flowers collected before sunrise. In the autumn of 1915 it was worth from 42/- to 45/- an English ounce. For other information see *K.B.* 1893, p. 22.

Patchouly Oil (*Pogostemon Cablin*, Bth.).

BRITISH.—India.

The oil is obtained from the leaves. Its value in 1915 was 20/- to 22/- per lb. For full particulars see *K.B.* Add. Ser. ix. Part iii. p. 534. *K.B.* 1908, p. 78.

Oil of Peppermint (*Mentha piperita*, L., and var. *officinalis*).

BRITISH.—British Isles. FOREIGN.—Japan, France, Germany, United States of America.

Peppermint is grown in several parts of England, but there appears to be room for an extension of its cultivation. The highest price obtained for the oil in 1915 was 14/6 per lb., the lowest price for American oil was 6/9 per lb. *Mentha arvensis*, L., is the source of Japanese Peppermint Oil.

Pine Oil (*Pinus* spp.).

FOREIGN.—Siberia, Bavaria, Switzerland, &c.

A somewhat similar oil is obtained from the leaves and young shoots of species of Abies, Larix and Picea. The oil was valued in 1915 at 1/6 to 4/6 per lb.

Sandalwood Oil (*Santalum album*, L.).

BRITISH.—Mysore.

Price in January, 1915, 22/- to 23/- per lb., price in December, 1915, 30/- to 32/- per lb.

Turpentine (*Pinus* spp.).

FOREIGN.—France, Germany, United States of America.

A great deal of turpentine is obtained from *Pinus Pinaster* in Western France, the chief port of shipment being Bordeaux. Turpentine is also obtained from *P. sylvestris* in various European countries, from *P. australis* (*P. palustris*) in the South-Eastern United States, and from *P. excelsa* and *P. longifolia* in the Himalaya. Venetian Turpentine is obtained from *Larix europaea*.

There are many more essential oils; some orders of plants, particularly *Labiatae*, *Lauraceae*, *Compositae* and *Umbelliferae*, being very rich in them, but the more important ones are mentioned in the above list.

GUMS, GUM RESINS AND RESINS.

Gum Arabic (*Acacia arabica*, Willd. and *Acacia Senegal*, Willd.).

British.—India, Egypt, Anglo-Egyptian Sudan, Nigeria, &c. Foreign.—Morocco, Senegal, &c.

The total amount of gum-arabic imported into the United Kingdom from all sources was, in 1913, 113,274 cwts., value £229,791, and in 1915 150,282 cwts., value £255,092.

Acacia Senegal is a tree native of Senegal, widely distributed in Tropical Africa and cultivated in India. In Kordofan the gum is obtained from both wild and cultivated trees, and the Arabic name of the best quality there is "Hashab." This tree yields the true gum-arabic of commerce usually known as "Kordofan," "Picked Turkey," "White Senaar" or "Senegal Gum," graded according to colour, size and general appearance.

Acacia arabica is a tree widely distributed in Tropical Africa, India, &c. It yields a large proportion of the gum-arabic of commerce, chiefly "Morocco," "Mogador" or "Brown Barbary" and "East Indian" (so-called because it comes into commerce from Aden and the Red Sea ports via Bombay).

An inferior sort known as "Suakim" or "Talki" gum is obtained from *Acacia Seyal*, Delile, one of the principal Acacias yielding gum in the Nile region.

The inferior quality sometimes complained of in certain supplies of gum-arabic may be due to a mixture of inferior sorts or inefficient grading. Variation in quality is also sometimes attributed to climate, soil, seasons, &c.

The most important centres of the trade in gum-arabic are Senegal and Kordofan, and the principal markets are (or have been) Antwerp, Barcelona, Bordeaux, Hamburg, Havre, Liverpool, London, Marseilles, Melbourne, New York and Trieste. Confectioners are probably the largest users.

Further particulars regarding gum-arabic and allied gums are to be found in *K.B.* Add. Ser. ix. Part ii. p. 288, and in *K.B.*, 1910, p. 133.

Gum Tragacanth (*Astragalus gummifer*, Lab.; *A. eriostylus*, Boiss. and Haussk.; *A. adscendens*, Boiss. and Haussk.; *A. brachycalyx*, Fisch.; *A. microcephalus*, Willd., and other species).

Foreign.—Spiny shrubs native of mountainous districts in Asia Minor, Persia, Syria and Greece. Smyrna and Basra are important trade centres in the countries of production, and the principal markets in Europe are London, Marseilles, Trieste, &c. See also *K.B.*, 1895, p. 238.

Asafoetida (*Ferula Narthex*, Boiss., and *F. foetida*, Regel).

F. Narthex or "Tibetan Asafoetida" is a native of the northern slopes of the mountains dividing Kashmir from Western Tibet. *F. foetida* grows on the East of the Sea of Aral and also in Northern Afghanistan, and furnishes "Persian Asafoetida."

Gum Ammoniacum (*Dorema Ammoniacum*, Don).

Northern Afghanistan, South-West and Northern Persia, and known in the trade as "Persian Ammoniacum."

Particulars of other Gums Ammoniac are given in *K.B.*, 1907, p. 375.

Myrrh (*Commiphora* spp.).

Somaliland, Southern Arabia.

Myrrh is usually shipped from Aden to Europe or Bombay.

Myrrh is dealt with in *K.B.*, 1897, p. 98.

Bdellium (*Commiphora* spp.).

India, Africa.

"Indian Bdellium" (*Commiphora Mukul*, Engl.) is a tree found in the dry parts of Sind, Kathiawar, &c. "African Bdellium" (*Commiphora africanum*, Engl.) is exported to Bombay from Berbera.

Rosin or Common Resin (*Pinus* spp.).

BRITISH.—India, &c. FOREIGN.—Belgium, France, Portugal, Spain, United States of America.

The amount of Rosin imported into the United Kingdom from all sources was in 1913 1,758,067 cwts., value £1,120,652, and in 1915 2,048,264 cwts., value £1,191,483.

Rosin is the residue after distillation of Oil of Turpentine. Indian Turpentine is obtained from *Pinus longifolia*, Roxb., American Turpentine from "Pitch Pine" (*Pinus palustris*, Mill.), and European Turpentine from "Scotch Pine" (*Pinus sylvestris*, L.). "Corsican Pine" (*P. Laricio*, Poir.) and "Cluster Pine" (*P. Pinaster*), of the Mediterranean region, yield the "Bordeaux Turpentine" of commerce.

Kauri or "Gum" Kauri (*Agathis australis*, Salisb.).

BRITISH.—New Zealand, from whence this country imported, in 1913, 145,633 cwts, value £602,851, and in 1915 64,692 cwts., value £293,263.

Lac (*Tachardia lacca*, Kerr), an insect belonging to the *Coccideae*).

BRITISH.—India, Straits Settlements. FOREIGN.—French Indo-China, Siam.

The lac insect lives upon various plants, principally *Butea frondosa*, Roxb., *Ficus religiosa*, L., *Schleichera trijuga*, Willd.,

Shorea robusta, Gaertn., *Zizyphus Jujuba*, Lam., &c., and in some parts plants are grown specially for feeding this insect as *Acacia arabica*, Willd., in Sind, and *Cajanus indicus*, Spreng., in Assam, &c.

Lac yields a dye and a resin; the chief source of the Lac-dye, Seedlac, Shellac and Sticklac of commerce is British India, from whence, in 1913, this country imported 107,015 cwts., value £411,761, the total from all sources for the same year being 108,739 cwts., value £418,447. In 1915 the total from all sources imported into the United Kingdom was 113,470 cwts., value £355,122.

Amongst other resins more or less of commercial importance may be mentioned "Gum Accroides" or "Grass Tree Gum" obtained from *Xanthorrhoea hastilis*. R. Br., *X. arborea*, R. Br., *X. Preissii*, Endl., *X. australis*, R. Br., &c., natives of Australia; "Guaiacum" obtained from the stem of *Guaiacum officinale*, L., a tree native of Tropical America, and *G. sanctum*, L., native of Southern Florida, Bahamas, Cuba, &c.; "Mastic" (*Pistacia Lentiscus*, L.) from the Greek Archipelago, chiefly in Scio; "Elemi" or "Gum Elemi" (or Soft Resin) from *Canarium luzonicum*, A. Gray, native of the Philippine Islands; "Benzoin" or "Gum Benjamin" or "Sumatra Benzoin" (*Styrax Benzoin*, Dryand.), from Sumatra and "Siam Benzoin" (*Styrax* sp.) from Siam; "Piney Resin," "Indian Copal" or "White Dammar" (*Vateria indica*, L.), native of Southern India; "Dammar" (*Agathis loranthifolia*, Salisb.), a Conifer, native of Burma and the Malay Peninsula; "Copal" "Anime" or "Zanzibar Copal" (*Trachylobium Hornemannianum*, Heyne), native of Zanzibar; a similar product is obtained from the "West Indian Locust Tree" (*Hymenaea Courbaril*, L.), from British Guiana; "Inhambane Copal" (*Copaifera Gorskiana*, Benth.), from Mozambique; "Sierra Leone Copal" (*Copaifera Guibourtiana*, Benth.); "Accra Copal" (*Copaifera* sp.) from the Gold Coast and "Ogea" (*Daniellia Ogea*, Rolfe, and probably other species) from Lagos and Southern Nigeria, &c.

The following Gums and Resinous Substances have been discussed in the *Kew Bulletin*:—

"Bengal Kino Tree (*Butea frondosa*)," Sept., 1887, p. 20, and "*Butea frondosa*," Add. Series ix. Part ii., p. 222.

"Brazilian Gum Arabic," 1888, p. 128: correspondence between the Royal Gardens, Kew, and the British Consulate, Para; on "Jatuba" (*Hymenaea* sp.) and "Angico" (*Acacia Angico;* determined later on specimens received at Kew as *Piptadenia macrocarpa*).

"Inhambane Copal (*Copiafera Gorskiana*)," 1888, p. 281.

"Dammar from New Caledonia," 1891, p. 76.

"Siam Products," 1892, p. 312; specimens sent to Kew by Mr. W. R. D. Beckett, of H.M. Legation, Bangkok; probably *Shorea robusta*; reported on for Kew by Mr. R. Ingham Clark, West Ham Abbey, Stratford, London, E.

"Gum Tragacanth," 1894, p. 36; Extract from Foreign Office Report on the Trade of Baghdad and Bussorah, No. 1320, 1894 and 1895, pp. 238–239.

"Siam Benzoin," 1895, p. 154 and p. 195; "The Source of Siam Benzoin (*Styrax benzoides*)," 1912, p. 391.

"Siam Gamboge (*Garcinia Hanburyi*)," 1895, p. 139.

"Myrrh and Bdellium," 1896, p. 86, including "Arabian Myrrh," "African Bdellium," "Opaque Bdellium," "Bissa Bôl. Hotai," and "Indian Bdellium," "Myrrh," 1897, p. 98. "*Commiphora africanum*," Additional Series ix. Part i., p. 140.

"Kino from *Myristica malabarica*." 1897, p. 101.

"Incense Trees of the West Indies," 1898, p. 239, including *Bursera gummifera*, the "Birch Tree" of Jamaica, the "Gommier" of the Windward and Leeward Islands, and the "Turpentine Tree" of St. Vincent; *Dacryodes hexandra*, the "Mountain Incense Tree" or "Gommier" of Dominica; and *Protium guianense*, indigenous to the mainland of South America.

"*Trachylobium Dewevrianum*," 1899, p. 139, a newly-discovered Copal from the Congo; sample reported upon, for Kew, by Messrs. Ingham Clark & Co., West Ham Abbey, Stratford, valued at about £40 per ton.

"East Indian Dragon's Blood (*Daemonorops* spp.)," 1906, p. 197, Malay Penisula, Sumatra and Borneo.

"Persian Gum (*Amygdalus leiocarpa*)." 1906, p. 109.

"Ogea Gum (*Daniella* and *Cyanothyrsus*)," 1906, p. 199: "*Daniellia*," Add. Series ix. Part ii., p. 268; "*Paradaniellia Oliveri*," Add. Ser. ix. Part 2, p. 270; 1912, p. 96.

"The Gums Ammoniac of Morocco and the Cyrenaica (*Ferula communis*, var. *brevifolia*)," 1907, p. 375.

"Sudan Gum," 1907, p. 23.

"African Kino (*Pterocarpus erinaceus*)." Add. Series ix. Part 2, p. 239-240.

"Gum Arabic (*Acacia* spp.)," Add. Series ix. Part ii., p. 288, including *Acacia arabica*, *A. Senegal*, &c.

Various Gums and Resins are dealt with in Colonial Report, Misc. Series, No. 63, 1909, "Selected Reports from the Scientific and Technical Department, Imperial Institute," pp. 1-202.

Reference might also be made to "A Few Notes on Varnish and Fossil Resins," by R. Ingham Clark, pp. 1-69, in which is acknowledged, to the Royal Gardens, Kew, "such information on the subject as the Gardens afford."

The imports with the corresponding values, given under "Gum Arabic," "Rosin," "Kauri," and "Lac," are taken from "The Annual Statement of the Trade of the United Kingdom with Foreign Countries and British Possessions," Vol. i., 1915, and "Accounts Relating to Trade and Navigation of the United Kingdom, Dec., 1915," and as with Dyes and Tanning

Materials, figures are not readily separated from the returns given in reference to some of the products mentioned in the above notes; the "Unenumerated" Gums from Foreign Countries amounting for instance in 1913 to 162,065 cwts. value £392,588 and from British Possessions in the same year, including Sierra Leone, Gold Coast, Zanzibar, Aden, British India, Straits Settlements, Australia, &c., to 67,535 cwts., value £135,498.

RUBBER, GUTTA-PERCHA AND BALATA.

Para Rubber (*Hevea brasiliensis*, Muell. Arg.).

British.—Ceylon, Straits Settlements, Federated Malay States. Foreign.—Brazil-Amazon Region, Dutch East Indies.

Under cultivation in West Africa—Sierra Leone, Gold Coast, Togoland, Nigeria, &c., in Trinidad, Dominica, Mauritius, Seychelles, East Africa, Zanzibar, &c.

Plants or seeds were distributed to the various Colonies from the Royal Botanic Gardens, Kew, beginning about 1873. The returns of rubber imported into the United Kingdom show that plantation rubber from British Possessions in the East now exceeds that from wild trees in Brazil, the original home of the plant. The imports in 1915 were, from the Straits Settlements 660,532 centals (of 100 lb.) value £7,384,830; Federated Malay States, 288,803 centals, value £3,340,071; and from Ceylon, 286,097 centals, value £3,230,218, or a total from these Possessions of 123,543,200 lb., value £13,955,119, against 28,639,100 lb., value £3,240,779 from Brazil. See also *K.B.*, 1907, p. 153; 1908, p. 379; 1914, p. 162; 1917, p. 118.

Ceara Rubber (*Manihot Glaziovii*, Muell. Arg.).

Foreign.—Brazil, German East Africa.

Cultivated in India and the Colonies mentioned under *Hevea*. "Jequie Manicobas" (*Manihot* spp.) natives of Brazil, and recently introduced to many British Colonies, are fully discussed in *K.B.* 1908, p. 59, and 1910, p. 204.

Assam Rubber (*Ficus elastica*, Roxb.).

British.—Assam, Burma, Federated Malay States. Foreign.—Java, Sumatra.

Distributed by cultivation to the Colonies mentioned above.

Lagos, Silk or West African Tree Rubber (*Funtumia elastica*, Stapf).

Foreign.—French West Africa, Cameroons, Liberia, &c.

Cultivated on a large scale in most of the West African Colonies and Uganda, in the Cameroons, Congo, &c., and distributed to Trinidad, Straits Settlements, and other Tropical Countries out of Africa by seeds or plants from the Royal Botanic Gardens, Kew, beginning about 1896. For references see *K.B.*, 1905, p. 56; 1907; p. 187; 1909, p. 147; 1910, p. 206; 1911, p. 125. Add. Ser. ix Part iii., p. 451.

African Vine Rubber (*Landolphia* spp.).

British and Foreign Tropical Africa. Believed to come exclusively from wild vines but under experimental cultivation in West Africa and other Colonies. See *K.B.* Add. Ser. ix. Part iii., p. 428.

Borneo Rubber (*Willughbeia* spp. and *Leuconotis* spp.).

Borneo and Malaya.

Central American Rubber (*Castilloa elastica*, Cerv.).

British.—British Honduras. Foreign.—Nicaragua, Guatemala, Mexico, Ecuador.

Cultivated with success in Trinidad, and under experimental cultivation in most of the British Colonies in the Tropics, having been distributed from Kew, beginning about 1875, to Ceylon, Singapore, Fiji, Mauritius, West Africa, West Indies, &c.; also to Java. See *K.B.*, 1899, p. 159.

Mangabeira Rubber (*Hancornia speciosa*, Gomez).

Foreign.—Brazil, chiefly shipped from Pernambuco and sometimes called "Pernambuco Rubber." *K.B.*, 1892, p. 67; 1899, p. 185.

Abba Rubber (*Ficus Vogelii*).

British.—West Africa; sometimes called "Lagos Rubber." For particulars see *K.B.*, 1888, p. 253; 1890, p. 89.

Touckpong and Colombian Virgen Rubber (*Sapium* spp.).

British.—Guiana.—Foreign.—Colombia, Bolivia, &c. Sometimes also called "Bolivian," "Colombian," or "Esmeralda" "Scrap Rubber."

Guayule (*Parthenium argentatum*, A. Gray).

Foreign.—Mexico. *K.B.*, 1907, p. 285; 1908, p. 255; 1910, p. 211.

Colorado Rubber (*Hymenoxys* sp.).

Foreign.—Colorado.

Both of these plants are wild, yielding an inferior description of rubber, and are exceptional as belonging to *Compositae*, an Order not usually associated with the product obtained from trees with a milky juice.—*Apocynaceae*, *Euphorbiaceae*, &c.

The foregoing are the principal rubbers of Commerce, and the imports into this country are usually entered according to country of origin without reference to botanical source.

The countries of production include under British Possessions: Gambia, Sierra Leone, Gold Coast, Nigeria, Natal, East Africa Protectorate, Zanzibar and Pemba, India, Straits Settlements, Federated Malay States, Ceylon and Dependencies, Borneo, &c. (from whence, in 1913, came 776,790 centals, value

£11,739,834). Under Foreign Countries: Dutch East Indies, Dutch Guiana, German West and East Africa, French West Africa, Somaliland, Madagascar, Portuguese West and East Africa, Congo, Liberia, Mexico, Colombia, Venezuela, Ecuador, Peru, Chile, Brazil, Uruguay; Bolivia, Argentine Republic, &c. (from whence, in 1913, came 797,649 centals, value £8,784,185).

The total amount from all sources in 1913 is therefore 1,574,439 centals, value £20,524,019; and in 1915 1,825,659 centals, value £20,225,060 were imported, the figures for this year showing that the British Possessions supply the greater quantity of rubber to the Home country.

Gutta-Percha (*Palaquium Gutta*, Burck., &c.).

British.—Malaya. Foreign.—Java, Sumatra.

Native of Malaya; cultivated in the Straits Settlements and Java. Distributed to many British Colonies in the Tropics from Kew.

Pontianak Gutta (*Dyera costulata*, Hook.f.), from Malaya and Borneo.

Balata (*Mimusops bidentata*, DC.).

British.—Guiana. Foreign.—Venezuela, Dutch Guiana.

This is the chief forest product of British Guiana. The latex is sometimes adulterated with that of "Touckpong" Rubber (*Sapium Jenmani*), and the imports appear to be entered as "Gutta-Percha," the total from all sources being given in 1915 as 75,894 cwt., value £668,431. In 1913, 111,240 cwt., value £1,370,658, were imported into the United Kingdom.

Further particulars of all the above rubbers are given in *Kew Bulletin*, Additional Series vii., "Rubber," 1906, or in subsequent issues of the *Bulletin*. See also Colonial Reports, Miscellaneous, No. 82, 1912, "Selected Reports from the Scientific and Technical Dept. Imp. Institute: "Rubber and Gutta-Percha," pp. 1-447: Rubber Cultivation in Togoland and German East Africa, *K.B.*, 1911, p. 97.

The following have been discussed in the *Kew Bulletin*:—

"New Rubber-Containing Plants," 1908, p. 199.

"A New Rubber Plant (*Asclepias stellifera*)", 1909, p. 345, from the Transvaal, sample from the root valued by Messrs. Hecht, Levis & Kahn for Kew (14. iv. 09) at about 4/6 per lb.

"Ecanda Rubber (*Raphionacme utilis*)," 1908, p. 209; p. 305. Tubers from Benguela and details of tubers sent to Kew by the Companhia de Moçambique, examined in the Jodrell Laboratory at Kew.

"A New Rubber Tree: Palo Amarillo (*Euphorbia fulva*)," 1907, p. 294, and 1909, p. 392.

"Nandi Rubber (*Landolphia ugandensis*)," 1910, p. 304, a first-rate rubber from Uganda, the vine found growing at an altitude of 4000 ft.

"Rubber Cultivation in Togoland and German East Africa," 1911, p. 97.
"The Introduction of Para Rubber to Buitenzorg," 1914, p. 162.
"Wild Rubber & Selection, 1915, p. 183.
"Rediscovery of Gutta Percha Tree at Singapore," 1891, p. 230; "New Process for recovering loss," p. 231.
"Indian Gutta Percha," 1892, p. 296.
"Extraction of Gutta Percha from leaves," 1897, p. 200.
"Gutta Percha Trees of the Malay Peninsula," 1907, p. 109. "Palaquium," Add. Ser. ix., pt. iii. p. 403.
"Balata," 1911, p. 198. Add. Ser. ix. Part iii. 415.

DRUGS.

Aconite (*Aconitum Napellus*, L.).

British.—British Isles (Cultivated). Foreign.—Swiss Alps, Salzburg, North Tyrol, Vorarlberg.

A good deal of Aconite root has been obtained from Switzerland and Germany; the cultivation of the plant might be extended in the British Isles. Japanese Aconite Root is from *A. Fischeri*, and probably other species. Dried root from foreign sources other than Japan is usually worth about 50/- per cwt., Japanese root at the same time sells for about 35/- per cwt., and English root for about 2/- per lb.

Aloes (*Aloe* spp.). Inspissated juice from the leaves.

British.—South and East Africa, particularly Zanzibar, India, West Indies. Foreign.—Curacao.

In February, 1916, Zanzibar Aloes were valued at 75/- to 87/6 per cwt. and Curacao Aloes at 72/6 to 87/6 per cwt. Cape Aloes sold for 39/- per cwt.

Dill Fruits (*Peucedanum graveolens*, Bth. and Hk. f.).

British.—British Isles. Foreign.—Netherlands and various parts of Central and Southern Europe.

It is probable that the cultivation of Dill could be extended profitably in the British Isles. The plant is also grown in India.

Chamomile Flowers (*Anthemis nobilis*, L.).

British.—British Isles. Foreign.—Hungary, Italy, Germany, Belgium.

More Chamomile Flowers might be produced in the British Isles. The present price of the flowers is from 115/- to 140/- per cwt., according to quality.

Horseradish Root (*Cochlearia Armoracia*, L.).

FOREIGN.—Belgium, France, Germany, Holland.

A large quantity of Horseradish Root is imported for use in medicine and as a condiment. It is probable that the whole of the wants of the British Isles could be supplied from home-grown plants. At the present time very little is grown here from a commercial point of view, although a small plot is found in most kitchen gardens.

Asafoetida (*Ferula Narthex*, Boiss., and *F. foetida*, Regel, &c.).

FOREIGN.—Mountains of Persia and Afghanistan.

A gum-resin obtained from the roots.

Belladonna (*Atropa Belladonna*, L.).

BRITISH.—British Isles. FOREIGN.—Germany, Austria, &c.

The country might easily be self supporting in this drug. In 1913 the price of dried leaves was from 38/- to 60/- per cwt. It is now 200/- to 300/- per cwt. The roots are also employed medicinally.

Balsam of Peru (*Myroxylon Pereirae*, Klotzsch.).

FOREIGN.—State of Salvador, Cent. America.

The balsam exudes from the trunk after it has been beaten and scorched. Value in February, 1916, 21/- to 21/6 per lb.

Balsam of Tolu (*Myroxylon Toluifera*, H.B. and K.).

FOREIGN.—Colombia and Venezuela.

This and the last named might perhaps be produced in the West Indies or in British Guiana.

Bael Fruit (*Aegle Marmelos*, Corr.).

BRITISH.—India.

The drug is manufactured from the unripe fruit. There does not appear to be room for much development in the production outside India. It is occasionally imported.

Buchu (*Barosma* spp. particularly *B. betulina*, Bart.).

BRITISH.—South Africa.

It is doubtful whether the cultivation of Buchu could be conducted satisfactorily outside S. Africa. The forestry officials in S. Africa now exercise supervision over the collection of Buchu leaves. Between Jan. 1st, 1915, and Nov. 30th, 1915, 142,495 lbs. of Buchu leaves, valued at £26,575, were imported into the British Isles.

Calumba Root (*Jatorhiza Columba*, Miers).

FOREIGN.—Portuguese East Africa, &c.

Camphor (*Cinnamomum Camphora*, Nees.).

BRITISH.—Ceylon (cultivated). FOREIGN.—Formosa, Japan, China.

In February, 1916, crude Camphor was valued at 165/- a cwt. and refined Camphor at 1/7 per lb. for $2\frac{1}{2}$ lb. slabs. Particulars of the distillation of Camphor are given in *K.B.*, 1907, p. 88.

Caraway Seeds (*Carum Carvi*, L.).

BRITISH.—British Isles, India. FOREIGN.—Holland.

This crop might be grown more extensively in the British Isles. The "Perfumery and Essential Oil Record" for February, 1916, pp. 32-33 and p. 38, directs attention to the extensive area of land usually employed for the cultivation of this plant which has been devastated by the recent floods in Holland. The price of Caraway Seed in Feb., 1916, was from 56/6 to 57/6 per cwt.

Indian Hemp (*Cannabis sativa*, L.).

BRITISH.—India. FOREIGN.—Russia, Temperate Asia.

Cloves (*Eugenia caryophyllata*, Thunb.).

Malay States, Mauritius, Zanzibar, West Indies, &c.

Cloves of commerce are the unopened flower-buds of *Eugenia caryophyllata*. The present price is about 7d. per lb. wholesale.

Cascara Sagrada (*Rhamnus Purshiana*, DC.).

FOREIGN.—Western N. America, particularly California.

It is probable that this bush might be grown profitably in the milder parts of the British Isles. Bark from English-grown plants has been manufactured and found to be equal in merit to American-grown bark. Dried bark was valued at 52/6 per cwt. in February, 1916.

Cinchona Bark (*Cinchona* spp., particularly *C. Calisaya*, Wedd., *C. Ledgeriana*, Moens, and *C. succirubra*, Pav.).

BRITISH.—India, Jamaica. FOREIGN.—Peru, Ecuador, Java.

Quill and broken quill bark was sold at $7\frac{1}{2}$d. to $9\frac{1}{2}$d. per lb. in February, 1916. For particulars of Cinchona see *K.B.*, 1888. p. 139; 1890, pp. 29 and 54; 1894, p. 327.

Cocaine, Coca (*Erythroxylon Coca*, Lawk.). The leaves.

FOREIGN.—Peru.

The plant is also cultivated in Ceylon. Cocaine is worth about 21/- per oz., less 5 per cent. for hydrochloride, at the present time.

Colchicum Corm (*Colchicum autumnale*, L.).

BRITISH.—British Isles. FOREIGN.—Central and Southern Europe, N. Africa.

Both corms and seeds are used. It is possible that a greater quantity could be produced in the British Isles.

Senna Leaves, Alexandrian Senna (*Cassia acutifolia*, Delile). **Tinnevelly Senna** (*C. angustifolia*, Vahl.).

Egypt, Arabia.

Other species of *Cassia* also have medicinal properties, including *C. Fistula*, L., *C. marylandica*, L., and *C. obovata*, Collad. Pods and flowers are used as well as the leaves in some cases. Senna leaves are worth up to 10½d. per lb.

Colocynth (*Citrullus Colocynthis*, Schrad.).

FOREIGN.—Smyrna, Trieste, France, Spain.

The fruit pulp.

Coriander (*Coriandrum sativum*, L.).

BRITISH.—British Isles (Essex). FOREIGN.—Russia, Germany, Holland, Morocco.

The fruits are at present valued from 17/3 to 19/- per cwt. It would probably pay to produce more fruits in the British Isles.

Datura Leaves and Seeds (*Datura fastuosa*, L., var. *alba*, *D. Stramonium*, L., and *D. Metel*, L.).

BRITISH.—British Isles. FOREIGN.—Germany, Austria.

It is probable that the British Isles could be made self-supporting with regard to this drug.

Digitalis, Foxglove (*Digitalis purpurea*, L.). The leaves.

BRITISH.—British Isles, wild and cultivated. FOREIGN.—Germany, Austria, &c.

A greater quantity could be produced in the British Isles.

Fennel Seed (*Foeniculum vulgare*, Mill.).

FOREIGN.—France, Austria, Persia, Japan, &c.

Seed is sometimes grown in the British Isles. Value February, 1916, 31/- to 32/- per cwt.

Gentian Root (*Gentiana lutea*, L.).

FOREIGN.—France, Germany, Switzerland, &c.

Price in February, 1916, whole root 62/6 to 65/- per cwt., cut root 72/6 per cwt.

Liquorice Root (*Glycyrrhiza glabra*, L.).

BRITISH.—British Isles (Yorkshire, near Pontefract). FOREIGN.—Belgium, Germany, Russia, Asia Minor, Persia, France, Spain, &c.

This crop was formerly grown more extensively than at present in the British Isles. Present price about 40/- per cwt.

Witch Hazel Bark (*Hamamelis virginica*, L.).

FOREIGN.—North America. This could probably be produced both in the British Isles and Canada.

Golden Seal or Hydrastis Rhizome (*Hydrastis canadensis*, L.).

North America.

This plant is sometimes grown for commercial purposes in the British Isles, but its cultivation might be extended.

Henbane (*Hyoscyamus niger*, L.).

BRITISH.—British Isles. FOREIGN.—Germany, Russia, Austria.

The leaves are the important part of the plant. English-grown leaves after drying are usually worth from 3/- to 6/- per lb. More might be grown in the British Isles.

Ipecacuanha Root (*Psychotria Ipecacuanha*, Stokes).

BRITISH.—India, Malay States. FOREIGN.—Brazil.

It would probably pay to grow this plant more extensively in British Colonies. In December, 1915, Matto Grosso root was valued at 24/- per lb. and Johore root at 20/- per lb. At the same time Cartagena root (*P. acuminata*, Benth. ?) sold for 16/- per lb.

Jalap (*Ipomoea Purga*, Hayne). The tubers.

FOREIGN.—Vera Cruz.

Myrrh (*Commiphora Schimperi*, Engl., and other spp.). Gum-resin.

Somaliland, Arabia.

The best grades sold in February, 1916, for 60/- to 62/6 per cwt.

Nux-vomica (*Strychnos Nux-vomica*, L.).

BRITISH.—India, Burma, Ceylon.

In December, 1915, the seeds were valued at 22/6 per cwt. An article on various species of *Strychnos* is to be found in *K.B.* 1911, p. 281. See also *K.B.* 1917, p. 121.

Ajowan Oil. See Essential Oils.

Oil of Cade (*Juniperus Oxycedrus*, L.).

FOREIGN.—South France.

Opium (*Papaver somniferum*, L.).

BRITISH.—Egypt, India. FOREIGN.—Asia Minor, Persia.

Rhubarb (*Rheum officinale*, Baill., and other spp.). The dried root.

BRITISH.—British Isles. FOREIGN.—North-West China, Tibet.

Santonin (*Artemisia maritima*, L., var. *Stechmanniana*). The dried unexpanded flower-heads.

FOREIGN.—Russian Turkestan.

At present almost unobtainable, price very high.

Squill (*Urginea Scilla*, Steinh.). The bulb.

FOREIGN.—Mediterranean region.

Stavesacre Seeds (*Delphinium Staphisagria*, L.).

FOREIGN.—Italy, Greece, Asia Minor.

Dandelion Roots (*Taraxacum officinale*, Weber).

BRITISH.—British Isles. FOREIGN.—Various European Countries.

Thymol (*Carum copticum*, Bth. and Hk. f., and other plants).

For list of various plants yielding Thymol see Essential Oil list.

Valerian Rhizome (*Valeriana officinalis*, L.).

BRITISH.—Grown in the British Isles. FOREIGN.—Europe, Asia, Japan.

Black Haw (*Viburnum prunifolium*, L.). The bark.

North America.

Cinnamon (*Cinnamomum zeylanicum*, Breyn.). The bark.

BRITISH.—Ceylon.

Chicory (*Cichorium Intybus*, L.). The dried root.

BRITISH.—British Isles. FOREIGN.—Belgium, France.

Castor Oil (*Ricinus communis*, L.). See Fatty Oils.

References to various Drugs.

"The Cultivation of Medicinal Plants in England," in Journal of the Board of Agriculture, No. 6, Sept., 1914; Reprinted as Leaflet No. 288 (obtainable on application to the Secretary, Board of Agriculture and Fisheries).

"The Cultivation of Medicinal Plants in Britain," by E. M. Holmes, in the "Pharmaceutical Journal," Jan. 2nd, 1915, pp.4-5, and Feb. 12, 1916, pp. 161-163.

Kew Bulletin:—

"Liquorice (*Glycyrrhiza glabra*)," 1894, p. 142.

"Ginseng in China," 1902, p. 4.

"Distillation of Camphor," 1907, p. 88.

"Cascara Sagrada" (*Rhamnus Purshiana*), 1908, p. 429; 1912, 393.

"A New Buchu from South Africa" (*Barosma Peglerae*), 1912, p. 326.

Additional Series ix., references to various drugs grown in Nigeria.

"American Medicinal Leaves and Herbs," by A. Henkel, U.S. Dept. of Agriculture, Bureau of Plant Industry, Bulletin No. 219, 1912.

"The Cultivation of Drug Plants in the United States," by R. H. True, U.S. Dept. of Agriculture, Year Book, 1903, pp. 337-346.

"The Commercial Possibilities in Growing Medicinal Plants," by F. A. Miller, in Lilly Scientific Bulletin, No. 5, April, 1914, pp. 163-168.

"The Cultivation of Medicinal Plants," by J. A. Borneman, in American Journal of Pharmacy, Dec., 1912, pp. 546-553.

"The British Pharmacopœia." Published under the direction of the General Council of Medical Education and Registration of the United Kingdom, pp. 1-602. (Constable & Co., Ltd., London, 1914.)

"Potter's Cyclopædia of Botanical Drugs and Preparations," by R. C. Wren, pp. 1-339. (Potter & Clarke, Ltd., London, 1914.)

DYEING AND TANNING MATERIALS.

Cochineal (small hemipterous insects fed on species of *Opuntia* and *Nopalea*).

FOREIGN.—Canary Islands, from whence in 1914 this country imported 2010 cwts., value £20,122, with 624 cwts., value £5,139, from other Foreign Countries.

Mexico, Guatemala, Java, &c., also produce this dye, and the plant and insect have been introduced to Algeria, Australia and India. See also *K.B.* 1888, p. 170.

Indigo (*Indigofera tinctoria*, L., and *I. arrecta*, *Hochst.*).

BRITISH.—India. FOREIGN.—Java, &c.

The imports from British India to the United Kingdom in 1913 were 3646 cwts., value £48,208, the total imported from all sources in the same year being 4174 cwts., value £54,739. The total amount of indigo imported in 1915 from all sources was 25,157 cwts., value £1,256,712.

Indigofera arrecta is largely grown in Africa, and as a source of Indigo was recommended (1905) by the Director, Royal Botanic Gardens, Kew, to the Government of S. Nigeria for cultivation there in preference to *I. tinctoria*. It was introduced to Java from Natal, and in India, according to Coventry (Watt, Comm. Prod. India), the Java plant shows an increase of 35 per cent. in the amount of green plant cut per acre, and of 45 per cent. increase in vat produce over the ordinary plant of the United Provinces.

Indigofera tinctoria is cultivated for commercial purposes, chiefly in India—Bengal, Madras, Bombay, Sind, &c.—and to some extent in the Straits Settlements, British Honduras, Philippine Islands, Central America, Colombia, and for local use in many tropical countries, including probably the whole of Tropical Africa.

Research work has been fostered for a number of years by the Government of India at specially organised research stations at Sirseah, Pusa, &c., and at the Imperial Institute and the University of Leeds. (See "Report to the Government of India, containing an account of the Research work on Indigo in the University of Leeds," 1905-1907, pp. 1-117, published by Order of the Secretary of State for India, 1908, and various reports issued by the Dept. of Agric., India). Further particulars are given in *K.B.*, 1910, p. 283, and in Add. Ser. ix. Part ii. p. 190.

Logwood (*Haematoxylon campechianum*, L.).

British.—West Indies—Jamaica, Mauritius, British Honduras, &c. Foreign.—Hayti, San Domingo, Mexico, &c.

In 1913, 8137 tons, value £42,534, from British Possessions, and 1492 tons, value £8,167, from Foreign Countries, were imported into the United Kingdom. A recent market report quotes £8 to £9 per ton.

The tree is a native of Central America and is shipped largely from Yucatan, where the Logwood cutters distinguish four varieties of the wood—"Tinta Negra," "Tinta Maria," "Tinta Catzim," and "Tinta Amarilla Catzim," according to the dye content. It has been naturalised in Jamaica, the most prominent British source of the wood, and has been introduced to Mauritius, Nigeria, and other Colonies.

"Bastard Logwood" is of no value for dyeing purposes, and the cause of the difference in the wood appears to be uncertain; botanically, no differences can be observed, and no distinguishing characters are evident until the trees are cut. Experiments have been undertaken (1903) at Hope Gardens, Jamaica, and the New York Botanical Gardens with seedlings of the trees producing normal and abnormal dye-wood to find out if possible the cause of this difference. For further particulars see *K.B.*, 1916, p. 221, and Add. Ser. ix. Part ii. p. 253.

Fustic (*Chlorophora tinctoria*, Gaud.).

British.—West Indies, Guiana. Foreign.—Brazil.

A dye-wood. Value on the London market £6 to £7 per ton.

The "Osage Orange" (*Maclura aurantiaca*, Nutt.) has been used in Texas as a dye-wood, and is recommended as a substitute for Fustic (see Agric. News, Barbados, Aug. 14th, 1915, p. 262). The tree is a native of North America, and the wood known there as "Bow wood" is largely used for fence-posts, paving blocks, &c.

Camwood (*Baphia nitida*, Lodd.).

British.—West Africa.

The heart wood is used as a dye, the value of which may vary from £5 to £12 per ton. A good deal of information will be found in *K.B.*, 1906, p. 373; 1908, p. 192; and Add. Ser. ix. Part ii. p. 246.

Barwood (*Pterocarpus Soyauxii*, Taub.).

Native of West Tropical Africa; the wood for dyeing was formerly of some importance in England, but it now appears to be unsaleable. For particulars of Barwood see *K.B.*, 1906, p. 373; 1908, p. 192; and Add. Ser. ix. Part ii. p. 242.

Sappan Wood (*Caesalpinia Sappan*, L.).

A red dye-wood imported into this country chiefly from Siam and the Philippines, but not of so much importance as formerly.

The Philippine production is exported largely to China. In India, where the tree is cultivated, the wood is chiefly used locally. The tree is being propagated for distribution by the Dept. of Agriculture, S. Nigeria. See *K.B.*, 1916, p. 211, and Add. Ser. ix. Part ii. p. 252.

Arnatto or Annatto (*Bixa Orellana*, L.). The fleshy covering of the seeds.

British.—West Indies, Ceylon, &c. Foreign.—Chiefly from South America. Prepared dye and seeds imported.

The price of the dye on the London market may vary from 1/- to 2/- per lb., and the seeds 4½d. to 6d. per lb., but the demand is more or less stationary, and has always been distinctly limited. Native of Tropical America, naturalised in West Africa, and distributed by cultivation to most of the tropical Colonies. For particulars see *K.B.*, 1887, July, p. 1; September, p. 1; and 1890, p. 141.

Woad (*Isatis tinctoria*, L.). The plant.

An ancient industry until lately carried on near Wisbech, Cambridgeshire, and at Boston and Holbeach, Lincolnshire (see "Nature," Nov. 12th, 1896, pp. 36-37, and *K.B.* 1902, p. 15). The dye was used in combination with indigo.

Safflower (*Carthamus tinctorius*, L.). The flowers.

British.—India. Foreign.—France, Spain, &c.

As a dye for silks and cottons, Safflower, once of considerable importance, is, in common with Madder (*Rubia tinctorum*) and others, now almost forgotten in this country, owing to the development of synthetic dyes, though in India it appears to have lost nothing of importance for local use.

The imports of Safflower into the United Kingdom 50 or 60 years ago were calculated in tons (405 tons in 1847, 506 tons in 1848, &c.), the price according to quality being from £1 to £8 per cwt., imported from Bombay and Bengal. The last year in which returns are shown by the Customs is 1899, when 20 cwt., value £62, came in from India. The exports of the dye from India now go mainly to Hong Kong.

The plant is cultivated in the Sudan, Nubia, Senaar, India, China, Abyssinia, S. Europe, &c. Further details will be found in *K.B.* Add. Ser. ix. Part iii. p. 392.

Saffron (*Crocus sativus*, L.). Stigmas of the flowers.

Foreign.—Grown for commercial purposes in France, Spain, Italy, &c., formerly used as a dye, but has been superseded by cheaper materials, the principal use at the present time being as a condiment or flavouring agent.

Quercitron Bark (*Quercus discolor*, Ait.), from North America; used as a dye and for tanning purposes.

Persian or Yellow Berries (*Rhamnus infectoria*, L.), grown in Asia Minor, Persia, &c.

Gambier (*Uncaria Gambier*, Roxb.). Extract from the leaves and shoots.

British.—Straits Settlements and Dependencies. Foreign.—Dutch Possessions in the East Indies.

In 1913 81,352 cwts., value £115,168, from British Possessions, and 20,360 cwts., value £26,858, from Foreign Countries, or a total of 101,712 cwts., value £142,026, were imported into the United Kingdom. In 1915 the total from all sources imported to this country amounted to 208,748 cwts., value £306,698.

The plant has been recommended by Kew for cultivation in various Colonies, West Africa, West Indies, &c., but so far it does not appear to have been commercially successful anywhere other than in or near the original countries of production. Used for dyeing and tanning. Additional information will be found in *K.B.* 1889, p. 247, Add. Ser. ix. Part iii. p. 346.

Myrobalans (*Terminalia Chebula*, Retz.).

British.—India, Burma.

In 1913 564,462 cwts., value £176,621, from British Possessions, chiefly British India, and 760 cwts., value £234, from Foreign Countries, or a total of 565,222 cwts., value £176,855, were imported into the United Kingdom. In 1915 the total from all sources imported to this country amounted to 778,984 cwts., value £292,297.

It is the dried fruits that come into commerce, and, in addition to being used as a tanning material, a valuable yellow or brown dye is extracted. See also *K.B.* 1909, p. 209.

Sumach (*Rhus* spp.). Leaves and Twigs.

British.—Cyprus. Foreign.—Spain, Italy, Tunis, &c.

In 1913, 396 cwts., value £130, from Cyprus, and 163,704 cwts., value £83,031, were imported into the United Kingdom. In 1915 the total from all sources imported amounted to 143,333 cwts., value £84,040.

Three sorts of Sumach come into commerce (1) "Venetian Sumach," or "Young Fustic," the young twigs of *Rhus Cotinus*, L., a S. European species, yields a bright yellow dye, (2) "North American Sumach" (*Rhus glabra*, L.), and (3) the Sumach of the Mediterranean Region, the tanning material con-

sisting chiefly of the powdered leaves of *Rhus Coriaria*, L., a hardy shrub growing on rocky slopes in Sicily and elsewhere, cultivated near Palermo.

The Sumach plant (*Rhus Coriaria*, L.) has been successfully introduced to Australia, where it is said to thrive well in the dry plains of the Wimmera District. Samples of Sumach from Melbourne plants shown at the Exhibition of 1863 are in the Kew Museum. Further particulars are given in *K.B.* 1895, p. 293.

Valonia (*Quercus Aegilops*, L., and vars. *macrolepis* and *Ungeri*).

Foreign.—Greece, Smyrna.

In 1915 142,456 cwt., value £101,922, were imported into the United Kingdom.

The Acorn-cups are used by tanners and dyers.

Gall-Nuts or **Mecca Galls** (*Quercus Lusitanica*, Lam., var. *infectoria*, A. DC.).

Foreign.—Asia Minor.

Chinese Galls (*Rhus semialata*, Murray).

Foreign.—China and Japan.

Used for tanning, and mentioned as being used for dyeing in the Silk Industry at Lyons (see *K.B.* 1900, p. 5).

Divi-divi (*Caesalpinia coriaria*, Willd.).

British.—West Indies. Foreign.—South America, Venezuela, &c.

Native of Central and South America. Cultivated in India, Java, Australia, Gold Coast, Nigeria, East Africa, &c.

The pods are the part used for tanning, and an extract from them is also a useful dye. Additional information will be found in *K.B.* Add. Ser. ix. Part ii. p. 250.

Oak Bark (*Quercus* spp.).

The principal native tanning substance, and imported from the Continent of Europe, Belgium, &c.

Large quantities (324,070 cords, value 3,533,862 dollars) of Oak-bark, and also of the extract (36,930,861 lbs., value 703,805 dollars) are used in the United States annually (see Board of Trade Journ., June 30th, 1912) for tanning purposes.

Hemlock Spruce Bark (*Tsuga canadensis*, Carr., "Eastern Hemlock"; *Tsuga Mertensiana*, Carr., "Western Hemlock").

British.—Canada. Foreign.—United States.

Large quantities used in the United States for tanning. See also *K.B.* 1912, p. 81.

Mangrove Bark (*Rhizophora* spp.).

British.—East Africa, Zanzibar, &c. Foreign.—Mozambique. Chiefly from *Rhizophora mucronata*, Lam., a species also found on the shores of India, Burma, &c., from whence also the bark is probably obtained for tanning in this country. Watt (Comm. Prod. India), states that it is exported from Mergui to Rangoon, and a considerable trade is also done in it from the Perak Coast.

"Gamfort" is a trade name for an extract (like "Cutch"), made on the coast of Borneo, near Sarawak. There is a sample of this in the Kew Museum, and it is believed to be obtained from a Mangrove bark, probably that of the species mentioned.

The best Mangrove bark or extract is not so acceptable to tanners as Oak Bark, Valonia, Quebracho, Mimosa Bark, &c.; the principal objection is its deep red colour, and it is only considered satisfactory for tanning leather when used in combination with better class substances. Some particulars of the "Cutch" Industry from Mangrove bark in Borneo are given in Journ. Soc. Arts, July 23, 1909, p. 737. See also *K.B.* 1892, p. 227; Add. Ser. ix. Part ii., p. 304.

Quebracho Colorado (*Quebrachia Lorentzii*, Griseb.). Wood and Extract imported chiefly from the Argentine. *Quebrachia Morongii*, Britton, is known as "Quebracho Colorado" in Paraguay, where the wood is ground up and used for tanning purposes.

Wattle Bark or **Mimosa Bark** (several species of *Acacia*, notably *A. mollissima*, Willd., *A. dealbata*, Link, *A. pycnantha*, Bth., &c.).

British.—Australia, Natal.

The cultivation of Wattle bark, which has been very successful in Natal (with *Acacia mollissima*, introduced from Australia), has also been undertaken in New Zealand, Hawaii, California, &c. Information about *A. saligna* especially will be found in *K.B.* 1893, p. 370.

Mallet Bark (*Eucalyptus occidentalis*, Endl., var. *astringens*).

British.—West Australia.

As a tanning substance this is comparatively new, some large shipments have been made, beginning about 1904, and the bark is regarded as a strong competitor of the more widely used Mimosa or Wattle Bark. See also *K.B.* 1911, p. 114.

Cutch or **Catechu** (*Acacia Catechu*, Willd.).

British.—India, Burma, &c.

The extract for tanning purposes is obtained by boiling the chips of the heart-wood of the tree. It is known in commerce as "Dark Catechu," "Black Catechu," "Pegu Catechu," or "Terra Japonica." The last name is also applied to the extract of *Uncaria Gambier*, Roxb. See also *K.B.* 1894, p. 323.

Chestnut Extract (*Castanea sativa*, Mill.). Extract from the wood.

FOREIGN.—France, Corsica, North America, &c.

In the foregoing list pages 270-273 are Dyes and pages 273-276 are Tanning materials, though some of the products may be used for both purposes. The imports into this country, with the corresponding values, are taken from "The Annual Statement of the Trade of the United Kingdom with Foreign Countries and British Possessions," Vol. i., 1915; and "Accounts Relating to Trade and Navigation of the United Kingdom, Dec., 1915." Figures are not readily separated from the returns given in reference to some of the products mentioned in the above notes, as, for instance, "Cutch" obviously includes the extract from Mangrove Bark (*Rhizophora mucronata*, &c.), and that from the wood of *Acacia Catechu;* the Tanning Barks include those obtained from *Acacia*, *Rhizophora*, and *Eucalyptus*, &c., but the absence of the figures herein may, perhaps, not so much matter when it is remembered that it is important in the case of all tanning materials and most dyes that large and regular quantities, as well as quality, must be assured to sustain the market in those well known, or before any new product can be accepted by the trade, and those enumerated are calculated to meet these requirements.

There are many Native Vegetable Dyes that might be mentioned in addition to "Woad" (*Isatis tinctoria*), but the cost of collecting and preparing the plants would probably be much in excess of that of the more reliable dyes now obtained from the Colonies and Foreign Countries, and it is not likely that the quantity available would be sufficient for general purposes. Many of the Native Dyes were formerly used, and are still in use at the present day, especially in the Highlands of Scotland, where those principally used are obtained from *Genista tinctoria*, L., *Reseda Luteola*, L., *Calluna vulgaris*, Salisb., *Iris Pseudacorus*, L., &c.

In the *Kew Bulletin* for 1894, p. 322, it is stated that "Competition with Aniline has ruined many of the Indian Dyes, such as 'Safflower' (*Carthamus tinctorius*, L.), 'Madder' (*Rubia cordifolia*, L.), but there seems no good reason why others should not take their places, either as regular crops or as important forest products. Among the former may be specially mentioned the 'Chay Root' (*Oldenlandia umbellata*, L.) and 'Al' (*Morinda citrifolia*, L.), which might be regularly and extensively cultivated, as these plants furnish dyes of a purity and depth of colour that defy imitation." The following Dyes and Tans have also been discussed in the *Kew Bulletin*:—

"Red Guinea Corn (*Sorghum vulgare*)," 1891, p. 219, cultivated as a red-dye in Yoruba.

"The Clove as a Dye Plant (*Eugenia caryophyllata*)," 1894, p. 417; used for dyeing in the Seychelles; reported on for Kew by Prof. Hummel, of the Yorkshire College, Leeds, "As a dye stuff it is of little value."

"Shu Lang Root (*Dioscorea rhipogonoides*)," 1895, p. 230, a dye-yam of China; extensively used in Pakhoi in dyeing coarse native cotton cloth and fishing nets a dark brown or tan colour, and for dyeing grass-cloth (*Boehmeria*).

"Indian Yellow or Piuri," 1890, p. 45, obtained from the urine of cows fed on Mango leaves in India.

"Maqui Berries (*Aristotelia Maqui*)," 1890, p. 34, used for colouring wine; shrub common in Chile.

"Artificial Indigo," 1898, p. 33.

"West African Indigo Plants," 1888, p. 74.

"Yoruba Indigo (*Lonchocarpus cyanescens*)," 1888, p. 268, and Add. Series ix. Part ii., p. 244.

"Paraguay Indigo (*Eupatorium laeve: E. tinctorium*)," 1892, p. 179; correspondence with the Foreign Office and report by Prof. Hummel.

"Shinia in Cyprus (*Pistacia Lentiscus*), 1897, p. 421, and 1898, p. 190.

"Tengah Bark (*Ceriops Candolleana*)," 1897, p. 91, used at Singapore for tanning and dyeing; report by Prof. Hummel, Leeds.

"Fungus Gamboge (*Polyporus hispidus*)," 1899, p. 23, specimens examined for Kew by Prof. Hummel, the Yorkshire College, Leeds, who reports "the colours obtained are not bright enough, nor is the fungus sufficiently rich in colouring matter to render it of commercial value in Europe."

"Siam Gamboge (*Garcinia Hanburyi*)," 1895, p. 139.

"Persian Zalil (*Delphinium Zalil*)," p. 111, and 1895, p. 167, where it is stated that "Although quite a good dye stuff for native use, the comparatively low colouring power of the flowers will prevent it from finding any employment in Europe."

"Geranium Wallichianum as a dye plant," 1896, p. 29; report by Prof. Hummel on the dye, and also one by Prof. Proctor as to suitability for tanning leather.

"Gambier Plants (*Uncaria Gambier*)," 1891, p. 106; correspondence between Kew and the Colonial Office on the introduction of the plant to the West Indies.

"Cape Sumach (*Colpoon compressum*)," 1898, p. 18.

"Valonia in Cyprus," 1888, p. 163; correspondence between the Royal Botanic Gardens, Kew, and the Crown Agents for the Colonies.

"Canaigre (*Rumex hymenosepalum*)," 1890, p. 63; 1894, p. 167; 1897, p. 200.

"Sumach, North American (*Rhus glabra*)," 1895, p. 293.

PAPER-MAKING MATERIALS.

Esparto (*Stipa tenacissima*, L.); part used, the plant-culms and leaves.

Foreign.—Spain, Algeria, Tunis, Tripoli.

An important fibre for paper-making. The imports in 1913 amounted to 204,957 tons; in 1914, 183,144 tons; in 1915, 137,538 tons; and in 1916, 149,358 tons; the average current prices on the 15th of December of each year mentioned being £3 5s. to £5 per ton, £3 10s. to £5 10s., £4 to £6, and £5 7s. 6d. to £6 2s. 6d. (based on a sea freight of 60s. per ton) per ton respectively (see Messrs. Ide & Christie's Monthly Circular).

Wood Pulp: **White Spruce** (*Picea alba*, Link); **Red Spruce** (*P. rubra*, Link); **Black Spruce** (*P. nigra*, Link); **Norway Spruce** (*P. excelsa*, Link).

British.—Newfoundland, Canada. Foreign.—Norway, Sweden.

The imports of Mechanical (Wet) Wood Pulp into the United Kingdom in 1915 included from Canada 37,501 tons, value £115,469; from Newfoundland, 25,232 tons, value £71,245. The principal foreign sources for this class of pulp are Russia (no returns for 1915), Sweden—imports in 1915, 135,078 tons, value £389,930; Norway, imports in 1915, 342,917 tons, value £922,378. Other forms of Wood Pulp, as "Chemical Dry, Bleached," "Chemical Dry, Unbleached," "Chemical Wet," "Mechanical Dry," chiefly foreign sources, Russia, Sweden, Norway, &c., were imported in the same year to an extent of more than 400,000 tons, value exceeding £3,800,000 (see Annual Statement, Trade of the United Kingdom, i. 1916, p. 184).

Hedychium coronarium, Koln., a plant of the Natural Order *Zingiberaceae*, native of India; distributed to Ceylon, Malacca, Central America, West Indies, West Africa, Mauritius, &c., naturalised in Brazil.

This plant, as a new source of paper-pulp, has been investigated by Messrs. Clayton Beadle & Stevens, 15, Boro., London Bridge. The experiments were made with dried material from Brazil, and with fresh stems grown in the Royal Botanic Gardens, Kew, and later with a supply of dried material from the Royal Botanic Garden, Sibpur, Calcutta (see *K.B.* 1912, p. 373: 1914, p. 165; and 1917, p. 104, for detailed accounts).

Amomum hemisphaerica, K. Schum., native of Java.

Alpinia nutans, Rosc., found in Hong Kong, Eastern Himalaya, Malay Peninsula, and the West Indies. Also in Guatemala, Venezuela, Surinam, Brazil, Formosa, and Cochin China.

Both these plants are similar in habit to the above-mentioned, and have also been investigated by Messrs. Clayton Beadle & Stevens for paper-making (see *K.B.*, 1912, p. 377).

In the *Kew Reports*, 1874-1880, some particulars of the following plants for paper-making are given:—

Lygeum Spartum, "Esparto Grass," 1876, p. 24; 1877, p. 37; *Stipa* (*Macrochloa*) *tenacissima*, "Esparto," 1876, p. 24; 1877,

p. 37; 1879, p. 33; *Adansonia digitata*, "Baobab," 1876, p. 24; *Fimbristylis spadicea*, 1876, p. 25; *Heliconia Bihai*, 1876, p. 25; *Lepidosperma gladiatum*, 1876, p. 25; *Uniola virgata*, 1876, p. 25; *Calotropis gigantea*, 1877, p. 37; 1880, p. 52; 1881, p. 32, 45; *Broussonetia papyrifera*, 1879, p. 33; *Yucca brevifolia*, 1878, p. 44; *Eriophorum comosum*, 1878, p. 45; *Phragmites communis*, 1876, p. 25; "Bamboo," 1876, p. 24; 1877, p. 35.

Later papers have appeared in the *Kew Bulletin* as follows:—

"Bhabur Grass (*Ischaemum angustifolium*)," 1888, p. 157; 1894, p. 367; Add. Ser. ii. "Vegetable Fibres," p. 253.

"Esparto (*Stipa tenacissima*)," 1898, p. 318.

"Lalang Grass (*Imperata arundinacea*)," 1909, p. 55.

"Marram Grass (*Ammophila arenaria*) for Paper-making," 1912, p. 396; and 1913, p. 363.

"Streblus Paper (*Streblus asper*)," Add. Ser. ii., "Vegetable Fibres," p. 46.

The specimens referred to are in the Museums at Kew, and there are many more that have been contributed from time to time which do not appear to have attracted any special notice.

The following plants have been under consideration in comparatively recent years, but their use does not yet appear to have become general for paper-making:—

Bamboo, *Bambusa polymorpha*, Munro; &c.

There are specimens of Bamboo paper in the Museum, contributed more than 40 years ago by Mr. Routledge, who published in 1875 a pamphlet on "Bamboo as a Paper-Making Material." In it he stated: "Of all the fibre-yielding plants known to botanical science there is not one so well calculated to meet the pressing requirements of the Paper-trade as 'Bamboo,' both as regards facility of economy and production, as well as the quality of the 'Paper Stock' which can be manufactured therefrom. . . . I have made 'Paper Stock' from a stem of *Bambusa vulgaris*, Schrad., sent me by Dr. Hooker, from the Royal Botanic Gardens at Kew, which, as measured by the gardener in the Palm-house, grew at the rate of three feet in a single week."

The Indian Forest Record, Vol. iv. Part v., contains a "Note on the Utilisation of Bamboo for the Manufacture of Paper-Pulp," by R. S. Pearson, printed on paper made from *Bambusa polymorpha*.

A sample of Bamboo Paper Pulp, made by the Société des Pulpes et Papeteries du Tonkin, presented to the Museum by Messrs. Ide & Christie in 1913, formed part of the first supplies in quantity that had come, so it was believed, from the East to England.

Amongst recent publications on this subject may be mentioned "Bamboo Fibre as a Paper Material," in "The Commercial Products of India," by Sir G. Watt (1908), pp. 108-110; and "Report on the Investigation of Bamboo as a material for Production of Paper-pulp," by W. Raitt, in the Indian Forest Records, Vol. iii. Part iii. 1912 pp. 1-37.

Common Reed (*Phragmites communis*, Trin.); two specimens of paper in the Museum, one made of reeds grown on the banks of the Tay, near Errol, 1876, and the other of reeds grown at Keyhaven, near Milford-on-Sea, 1916; but there appears to be no published information on this plant as a paper-making material.

Rice Grass (*Spartina Townsendii*, L.); specimen in the Museum of paper made from plants collected at Poole Harbour, Nov., 1916.

An article on this plant, "Rice Grass in Poole Harbour: Possible Use in Paper Making," will be found in Bournemouth Visitors' Directory, 1916.

Kaoliang (*Andropogon Sorghum*, var. *vulgaris*, Hack.: *Sorghum vulgare*, Pers.); specimen of "Kaoliang Paper" in the Museum from Dairen, Manchuria, received from the Japan-British Exhibition, 1910. In reference to this paper, the British Acting-Consul at Dairen (see Board of Trade Journal, March 9th, 1911, p. 531) reports that, "owing to the keen demand for the kaoliang cane for sundry domestic uses, it is impossible to obtain it for paper making in large quantities and at moderate prices, and there is consequently little prospect of the development of a kaoliang paper making industry in Manchuria. The cost of production of kaoliang pulp is slightly less than 5 sen (1¼d.) per lb." This grass is cultivated throughout India, Ceylon, and Africa, more particularly in the hotter parts of these countries, and in most, probably all, of our tropical Colonies.

Elephant Grass (*Pennisetum purpureum*, Schum.); this grass as a paper-making material is fully dealt with in the Bulletin of the Imperial Institute, xi. 1913, pp. 68-70. The material experimented with was from Uganda, and in the report it was stated: "On account of the light and bulky nature of 'elephant grass' it is very unlikely that the stems could be profitably shipped to Europe for paper-making, as they would probably only realise about the same price as Esparto grass of average quality. If, however, the stems were converted into pulp in Uganda by treatment with caustic soda, it is possible that a remunerative industry might be carried on, since the pulp would probably be of approximately the same value for paper-making as wood-pulp prepared by the soda process." *K.B.*, 1912, p. 309.

Papyrus (*Cyperus Papyrus*, L.). According to the Journal of the Royal Society of Arts, July 9th, 1915, p. 772, some experiments were conducted in 1908 at the Wellcome Tropical Research Laboratories, Khartoum, with this plant for making pulp, and experiments on a larger scale have been carried out by Messrs. Tullis, Russell & Co., and by Messrs. Thomas & Green, under the auspices of Messrs. Cross & Bevan. The results indicated a valuation about equal to Esparto.

The following are recent publications on the subject:—

"Paper and Paper Materials," in the Commercial Products of India, by Sir G. Watt, pp. 861-868.

"Paper Making Materials," in Colonial Report, Miscellaneous Series, No. 58, 1909 (Selected Reports from the Scientific and Technical Department, Imperial Institute), pp. 119-128.

"New Sources of Supply for the Manufacture of Paper," by Clayton Beadle and Henry P. Stevens, in Journal of the Royal Society of Arts, February 14th, 1913, pp. 347-363.

"The Empire's Resources in Paper-Making Materials," by S. Chas. Phillips, in the Journal of the Royal Society of Arts, May 21st, 1915, pp. 613-636.

FIBRES.

Cotton (*Gossypium* spp.). The seed hairs.

British.—India, East Africa, West Africa, West Indies, Egypt (from 1915) and other Possessions. The imports into the United Kingdom were in 1913—71,915,000 lb. value £1,931,963, and in 1915—566,954,700 lb. value £17,482,608. Foreign.—United States, Egypt, Brazil, Chili, Peru, Hayti, San Domingo, Turkey, G. E. Africa, Port. E. Africa, &c. The imports into the United Kingdom were in 1913—2,102,384,600 lb. value £68,638,584, and in 1915—2,080,699,500 lb. value £47,190,041.

The amount imported from Egypt in 1913 (then under Foreign Countries) was 402,669,400 lb. value £17,642,358. This under normal conditions would therefore be the most important source from British possessions and the United States the principal **Foreign Source.**

K.B. Add. Ser. ii. p. 11; Add. Ser. ix. part i. p. 76.

Kapok (*Eriodendron anfractuosum*, DC.). The seed hairs.

British. India, Ceylon, Togoland. Foreign.—Java, East Africa. Value 1913—2d. to 6¼d. per lb.; in 1915—Indian 4d. to 6d., Ceylon 5½d., Java 8d. to 8½d. spot, 7½d. c.i.f. per lb.

K.B. Add. Ser. ii. p. 27; Add. Ser. ix. part i. p. 87; 1913, p. 236.

Akund (*Calotropis gigantea*, Br., and *C. procera*, Br.). The seed hairs.

British.—India. Value 1915—2½d. to 3½d. per lb.

K.B. Add. Ser. ix. part iii. p. 463.

Java is the most important source of Kapok. It is there grown in plantations, the produce being exported chiefly to Holland. The cultivation has recently been taken up in Togoland and East Africa (see *K.B.* 1913, p. 236). Akund is inferior to Kapok but is classed with it in commerce; it has only recently come into the English market. Both Kapok and Akund are common in the Colonies of Tropical Asia and Trop. Africa and might be readily extended by cultivation.

Sisal Hemp (*Agave rigida*, Mill., var. *sisalana*, Pers.). Leaf fibre.

British.—India, East Africa, Natal, Bahamas. Foreign.—Mexico, East Africa. Value 1913—Indian, £17 to £27 per

ton, Mexican £26 10s. to £27 10s. per ton; in 1915—Indian £39, Natal £36 10s., Mexican £37 to £38.

The figures showing the general imports of this fibre are not readily accessible, being included under the broad term "Hemp". Mexico is the principal source, 824 tons, value £24,459, coming from that country to the United Kingdom in 1913, but large quantities are shipped to the United States; 949 tons, value £31,210, were imported into England in 1913. British East Africa and the Bahamas are perhaps the most successful Colonies in the production of this fibre, but considerable attention is being given to it in India, Jamaica, Natal, Uganda, Nyasaland, West Africa, Fiji, &c., and there appears to be no reason why the plant should not be grown successfully in any Colony possessing a hot climate and dry calcareous soil.

K.B. Add. Ser. ii. p. 130; 1908, p. 300; 1912, p. 354; 1913, p. 231; 1914, p. 350.

Mauritius Hemp (*Furcraea gigantea*, Vent.). Leaf fibre.

British.—Mauritius and St. Helena. Value 1913—£25 to £29 per ton; in 1915 £34 to £35 per ton.

The plant is under cultivation in India, Ceylon, Nyasaland, &c.

K.B. Add. Ser. ii. p. 208; 1916, p. 169.

Manila Hemp (*Musa textilis*, Née). Stem fibre.

Foreign.—Philippines, Java.

Manila hemp is the best of the white fibres used for making rope, which includes the two hemps above mentioned.

The plant has been cultivated in British North Borneo, and has been introduced from Kew to India, the West African and West Indian Colonies, &c.

K.B. Add. Ser. ii. pp. 95, 106.

New Zealand Hemp (*Phormium tenax*, Forst.). Leaf fibre.

British.—New Zealand, St. Helena. 21,824 tons, value £649.170, imported in 1913; and 14.512 tons, value £397,858, in 1915 to this country, from New Zealand.

This plant does not appear, so far, to have been grown on a commercial scale in any other Colony.

Flax (*Linum usitatissimum*, L.). Bast fibre.

British.—Ireland, Canada. Foreign.—Russia, Germany, Netherlands, Belgium, France, &c. Imports into the United Kingdom from the Foreign Countries enumerated in 1913—84,222 tons value £4,178,782, and from British Possessions 1913—48 tons, value £1,347.

The plant is under experimental cultivation in Cyprus, East Africa Protectorate, Transvaal, Orange River Colony, India (as a fibre plant, but an important source of the seed: see "Linseed"). In British East Africa Protectorate "the experiments

which have taken place during the last few years have had satisfactory results, and practical interest in this crop is now being displayed by a number of settlers. Some of the samples sent home were valued as high as £55 per ton and the yield also compares favourably with that in other countries" (Colonial Report Annual, No. 840, 1915, p. 22).

K.B. 1913, p. 319.

Sunn Hemp (*Crotalaria juncea*, L.). Bast fibre.

British.—India.

India, where the plant is largely cultivated, would appear to be the only commercial source, over 5000 tons a year being exported to England.

The plant is found in Ceylon and Burma; distributed to Malaya and Australia; introduced to Lagos Botanic Station, seeds being sent from Kew in 1888; cultivated experimentally in Ceylon and Italy.

K.B. Add. Ser. ix. part ii. p. 181.

European Hemp (*Cannabis sativa*, L.). Bast fibre.

British.—India. Foreign.—Russia, Germany, Italy, Japan, Belgium, France, Austria-Hungary, United States. The principal Foreign source is Russia, from whence in 1913 this country imported 12,818 tons, value £432,201. and in 1915—5321 tons, value £260,368. According to Watt (Comm. Prod. India), the exports of "Hemp" from India are mainly in the afore-mentioned "Sunn" or "Sann" Hemp (*Crotalaria juncea*).

Jute (*Corchorus capsularis*, L.). Bast fibre.

British.—India; principal centre of the trade, Bengal. Imports into the United Kingdom 1913—347,548 tons, value £9,182,226.

Cultivated experimentally in Nigeria and other parts of West Africa.

K.B. Add. Ser. ix. part i. p. 109.

Bimlipatam Jute (*Hibiscus cannabinus*, L.). Bast fibre.

British.—India; principal centre of the trade, Madras. Imported as Jute in association with the above mentioned. Cultivated in Nigeria and French West Africa. Grows wild in the Gambia, Sudan, and widely distributed in Tropical Africa where it is believed to be indigenous. The plant is also known as "Ambari Hemp," "Deccan Hemp," "Indian Hemp," "Bastard Jute," etc.

K.B. Add. Ser. ii. p. 9; ix. part i. p. 70.

China Jute (*Abutilon Avicennae*, Gaertn.). Bast fibre.

Foreign.—China.

Imported into this country as "China Jute," but usually in association with Jute proper (*Corchorus capsularis*). Grows wild in N.W. India.

K.B. Add. Ser. ii. p. 259.

Para Piassava (*Leopoldinia Piassaba*, Wallace). Amazon Region; principal centre of the trade, Manaos, shipped from Para.

K.B. Add. Ser. ii. p. 250.

Bahia Piassava (*Attalea funifera*, Mart.). Brazil. Value, £46 to £50 a ton (1915).

K.B. Add. Ser. ii. p. 248.

West African Piassava (*Raphia vinifera*, Beauv.). Petiole fibre; imported from Nigeria and the Gold Coast, also from Liberia and French Guinea. It is also known in the trade as "Lagos Bass." Value £30 to £32 a ton (1915).

K.B. Add. Ser. ii. p. 228; 1910, p. 169.

Madagascar Piassava (*Dictyosperma fibrosum*, Wright). Madagascar. Value, £45 to £60 per ton (1915).

K.B. Add. Ser. ii. p. 227.

These various Piassava fibres obtained from the sheathing bases of the leaves are used for making brushes. The palms from which they are obtained are all growing wild in their respective localities and apparently not under cultivation for fibre production.

A similar fibre, classed as "Piassava" is obtained from the sheathing bases of the "Palmyra Palm" (*Borassus flabellifer*, L.). native of India, Ceylon and Tropical Africa, value £45 to £48 for good, £36 to £50 for dyed and sized, and also from the "Kittool" or "Kitool" Palm (*Caryota urens*) found in India, Ceylon, Malaya, etc. The exports from India are not important and the fibre comes principally from Ceylon, this Colony having supplied the London Market for more than 50 years.

Rafia or **Raffia** (*Raphia pedunculata*, Beauv.). A Madagascar Palm. This is the principal source, being the cuticle of the young leaves, dried; it has also been obtained from *Raphia vinifera*, of West Africa.

K.B. Add. Ser. ii. p. 232.

Coir (*Cocos nucifera*, L.). The fruit husk.

British.—India and Ceylon, where the industry has been long established. Experiments have been made at Lagos in the production of this fibre (see *K.B.* Add. Ser. ii. Veg. Fibres, p. 245). The palm is common in all tropical Colonies, near the sea.

K.B. Add. Ser. ii. p. 245.

China Grass (*Boehmeria nivea*, Gaud.) and **Ramie** or **Rhea** (*Boehmeria nivea*, Gaud. var. *tenacissima*). Bast fibre. Native of China. Under experiment in India, and there is perhaps hardly a British Colony in which this fibre has not been under experiment during the past half century or so, but so far with-

out any conspicuous success on a commercial scale. A recent Trade Return (Messrs. Ide & Christie's Monthly Circular, December 15th, 1915) states: "China Grass.—Some little enquiry is about, but so far no result.—38s. to 45s. Rhea.—No business."

K.B. Add. Ser. ii. p. 52.

Bowstring Hemp (*Sansevieria* spp.). Leaf fibre.

British.—East Africa.

Cultivated experimentally in various parts of Tropical Africa, Sudan, Rhodesia, Transvaal, Nyasaland, East Africa Protectorate, Nigeria, Gold Coast, etc., also in South Australia, India, Ceylon, etc.

The genus *Sansevieria* includes many valuable species yielding fibres all covered by the term "Bowstring Hemp." It has been given considerable attention at Kew for some years past in order to determine the species, chiefly from living plants which have flowered from time to time. The results are embodied in a recent Monograph of all the known species, 54 in all (see *K.B.* No. 5, 1915, pp. 185-261). The fibres of many of the species from the various Tropical African Colonies have been under investigation at the Imperial Institute (see Colonial Report, Misc., No. 58, 1909).

K.B. Add. Ser. ii. p. 114.

The above-mentioned are the principal fibres of commerce. The prices in general are those of the London Market (from Messrs. Ide & Christie's Monthly Circular, December 15th, 1913, and December 15th, 1915). The imports with their corresponding values are taken from "The Annual Statement of the Trade of the United Kingdom," Vol. i. 1915, or "Accounts Relating to Trade and Navigation of the United Kingdom," December, 1915.

The following have been under examination at the Imperial Institute and at the Royal Botanic Gardens, Kew:—

Hibiscus esculentus, L., the "Okra" of West Africa. Native of India; distributed over the whole of Tropical Africa and naturalised in all tropical and many sub-tropical Countries.

Hibiscus lasiocarpos, Cav. (?) from Sierra Leone.

Hibiscus lunariifolius, Willd., Native of India; widely distributed in Tropical Africa; cultivated as "Ramma" or "Rama" in Kontagora, Northern Provinces, Nigeria.

Hibiscus quinquelobus, Don, the "Kowe" or "Corwey," of Sierra Leone, "Onigozi," of Benin.

Honckenya ficifolia, Willd., Sierra Leone, Gold Coast, Nigeria, the "Bolo-bolo" fibre of the Yorubas.

Sida rhombifolia, L. Widely distributed in Tropical Africa and in the Tropics of the Old and New Worlds.

Triumfetta cordifolia, Guill. et Perr., and *T. rhomboidea*, Jacq., widely distributed in Tropical Africa.

Urena lobata, L., "Toja" fibre of Lagos, "Bolo-bolo" of Yoruba, "Aramina," "Guaxima," or "Carapicho" of Brazil;

widely distributed in tropical regions of both hemispheres. *Urena sinuata*, L., a similar plant, as widely distributed and passing at times under the same native names; the name "Rama" as applied to *Hibiscus lunariifolius* is also applied to this plant in Nupe, Nigeria.

The above ten fibres would all be classed as "Jute" in the trade, though but two genera (*Triumfetta* & *Honckenya*) belong to the same Order (*Tiliaceae*), the remainder belonging to *Malvaceae*, and they are all recommended as efficient substitutes for the true or Bengal Jute (*Corchorus capsularis*). All these are bast fibres. Some particulars of them, with references to literature, are given in *K.B.* Add. Series ix. part i.

Many other fibres, too numerous to enumerate, suitable for papermaking, textile purposes and cordage, either in competition with or as substitutes for the established commercial kinds are also under consideration officially (see Colonial Report, Misc. No. 58, 1909, and *K.B.*, Additional Series ii., "Vegetable Fibres,") and under experimental cultivation in the various Colonies.

TIMBERS.

Detailed returns of quantities and values of different kinds of timber imported into the United Kingdom cannot be obtained except in a few instances for in Trade Returns the various woods are grouped as Furniture Woods, Building Woods, &c.

Douglas Fir, Oregon Pine (*Pseudotsuga Douglasii*, Carr.).

British.—British Columbia, Vancouver. Foreign.—United States of America (Oregon, Washington).

One of the most important woods of Western North America. Used for many purposes, such as light and heavy building work, railway sleepers, paving blocks, fencing, telegraph and telephone poles, furniture, &c. Although inferior to the best Pitch Pine it is recognised as one of the best substitutes for that wood, and it is used for the same work as European Redwood or Yellow Deal (*Pinus sylvestris*, L.). Its most unsatisfactory point appears to be that it does not absorb creosote so well as pine. The tree grows well in the British Isles, and is likely to prove one of the most valuable exotics for British forests. References to the species are:—

1. "The Growth and Management of Douglas Fir in the Pacific North-West," Circular No. 175, U.S. Dept. of Agriculture.
2. "Properties and Uses of Douglas Fir," Forest Service Bulletin No. 88, U.S. Dept. of Agriculture.

See also "Canadian Woods for Structural Timbers," Forestry Branch Bulletin, No. 59, Ottawa, 1917.

Scots Pine, Baltic Redwood, Yellow Deal (*Pinus sylvestris*, L.).

British.—British Isles. Foreign.—Russia, Norway, Sweden, Germany.

The commonest and most generally useful of European timbers. Used for all kinds of building purposes, paving blocks, scaffold

poles, pit props, railway sleepers, telegraph poles, and many other purposes. Substitutes are at present required. Douglas Fir, Lodgepole Pine, White Spruce, Yellow Poplar, or Canary Whitewood, and for pit props probably Mangrove, might be substituted. For further particulars see *K.B.* 1915, p. 274.

Silver Fir, White Fir (*Abies* spp.).

British.—Grown in the British Isles. Foreign.—Norway, Sweden, Germany, Switzerland, Oregon, Washington, California.

Used for carpentry, indoor finish of houses, telegraph and telephone poles (when preserved), toy making, carving, packing cases, and wood wool. Cultivation might be extended in the British Isles, and several species would probably grow well in South Africa and New Zealand. *Abies pectinata*, DC., is the chief European species, and *A. nobilis*, Lindl., *A. Lowiana*, A. Murr., and *A. grandis*, Lindl., some of the principal American species. Other information on White Fir is given in *K.B.* 1912, p. 83.

Spruce, White Deal (*Picea* spp.).

British.—Newfoundland, Canada, grown in the British Isles. Foreign.—Norway, Sweden, Russia, Germany, U.S. America.

Used for indoor finish of houses, common furniture, pit props, scaffold poles, paper pulp, toy making. *P. excelsa*, Link., supplies the bulk of European pulp wood, and *P. alba*, Link, the greater part of that from Eastern N. America. *P. sitchensis*, Trautv. and Mey., from Western N. America, is a valuable timber tree, and is very useful for planting on wet ground in exposed places in the British Isles and in other temperate countries. The wood of this species is used largely in the manufacture of aeroplanes under the name of Silver Spruce.

Lodgepole Pine (*Pinus contorta*, Dougl., and var. *Murrayana*, Engelm.).

British.—British Columbia. Foreign.—Oregon, Washington, S. Alaska. Timber used for general work in America. Might be used as a substitute for Scots Pine here.

American Red Pine, Canadian Red Pine, Norway Pine (*Pinus resinosa*, Soland.).

British.—Canada.

The timber is not considered to be of such good quality as the best Baltic Redwood, but it is used for many of the purposes to which Baltic Redwood is put, and would probably give good results for sleepers, pit props, and paving blocks.

Long leaf Pine, Pitch Pine (*Pinus palustris*, Mill.).

Foreign.—South-Eastern United States of America.

This wood has advanced rapidly in price during recent years, and it is probable that Douglas Fir may be used instead of it in the future for many kinds of work.

Western Yellow Pine (*Pinus ponderosa*, Dougl., and *P. Jeffreyi*, A. Murr.).

FOREIGN.—California.

The wood is useful for general building work, railway sleepers, pit props, paving blocks, and other purposes. The tree is not likely to be a commercial success in the British Isles, but would probably do well in S. Africa.

White Pine, Weymouth Pine (*Pinus Strobus*, L.).

BRITISH.—Canada.

Western White Pine (*Pinus monticola*, Dougl.).

BRITISH.—British Columbia, Vancouver.

The timber can be used for general building work and is of good quality. Substitutes are *Pinus koraiensis*, S. and Z., from Eastern Siberia, Korea, and adjoining countries, and *Pinus Lambertiana*, Dougl., from Oregon and California.

Maritime Pine (*Pinus Pinaster*, Soland.).

FOREIGN.—France, Portugal, Spain.

Although the wood of this tree is not of first-rate quality large quantities are used in South Wales for pit props. The tree is rich in turpentine and resin, and is valuable for planting on sand dunes near the sea. It is the source of considerable revenue in France, particularly by resin and turpentine, and might be grown extensively in the southern maritime counties of the British Isles. For further particulars see *K.B.* 1915, p. 271.

Monterey Pine (*Pinus radiata*, D. Don, or *P. insignis*, Dougl.).

This tree is a native of Monterey, S. California, but it does not cover a large area, and the wood from that region does not affect the timber markets. The species, however, grows with remarkable rapidity in the maritime counties of the milder parts of the British Isles, in S. Africa, Australia, and New Zealand. On this account it is being extensively planted in some places with a view to its wood being used for minor purposes, such as box making, rough fencing, firewood, &c.

Japanese Pine (*Pinus Thunbergii*, Parl.).

FOREIGN.—Japan.

This is a very useful timber. It can be used for many of the same purposes as Baltic Redwood, and as the tree grows well in the British Isles it might be worth growing under forest conditions.—See *K.B.* 1916, p. 259.

Western Red Cedar, Canoe Cedar (*Thuya plicata*, D. Don).

BRITISH.—British Columbia, Vancouver. FOREIGN.—Alaska, Oregon, Washington.

The wood has good lasting properties, and can be used for build-

ing, sleepers, telegraph and telephone poles, and many other purposes. The tree grows well in many parts of the British Isles, and is sometimes planted under forest conditions.

White Cedar (*Thuya occidentalis*, L.).

British.—Canada (Quebec and Ontario particularly). Foreign.—N.E. United States.

This wood could probably be used for pit props, poles and sleepers.

Californian Red-wood (*Sequoia sempervirens*, Endl.).

Foreign.—California.

Wood useful for building purposes, furniture, shop fittings, and many of the purposes for which pine wood is used. For further particulars see *K.B.* 1912, p. 75.

Deciduous Cypress (*Taxodium distichum*, Rich.).

Foreign.—S. United States.

The timber is useful for building purposes, ventilators, vats and water tanks. It stands damp well. The tree grows well in the British Isles. Other information regarding this tree will be found in *K.B.* 1912, p. 76.

Larch (*Larix* spp.).

L. europaea, DC., grown in the British Isles and imported from Germany, Russia, and probably other European countries. *L. occidentalis*, Nutt., grows in British Columbia, Vancouver, Washington, and Oregon.

Larch is very useful for building purposes, fencing, telegraph and other poles, sleepers, &c.

Larch timber can also be obtained from Canada, Siberia, and Japan. Further information on *Larix occidentalis* is given in *K.B.* 1912, p. 80.

Western Hemlock (*Tsuga Albertiana*, Veitch).

British.—Vancouver, British Columbia. Foreign.—Alaska, Oregon, Washington.

Used for building work, furniture, paper-pulp, &c. This tree is also known as *T. Mertensiana*, and is referred to under that name in *K.B.* 1912, p. 81.

Lawson Cypress, Port Orford Cedar (*Cupressus Lawsoniana*, A. Murr.).

Foreign.—Oregon, N. California.

Yellow Cypress (*Cupressus nootkatensis*, Lamb).

British.—British Columbia, Vancouver. Foreign.—Washington, Oregon.

The wood of both trees can be used for the indoor finish of houses, furniture, &c. The wood of *C. Lawsoniana* is also popular

for match making. Both trees can be grown quite well in the British Isles. For further particulars see *K.B.* 1912, p. 78.

Red Cedar (*Juniperus virginiana*, L.).

FOREIGN.—United States of America.

The best wood is used for the casings of lead pencils. Rough wood makes very durable fences. One of the most likely substitutes for this wood is *Juniperus procera*, Hochst., from British East Africa. See *K.B.* 1913, p. 221.

Poplar (*Populus* spp.).

BRITISH.—British Isles, Canada. FOREIGN.—Russia, United States of America.

The European species of greatest importance are *P. alba*, L., *P. canescens*, Sm., *P. nigra*, L., and *P. tremula*, L. Of American species *P. monilifera*, Ait., and *P. balsamifera*, L., supply a good deal of wood for export. *P. tremuloides*, Michx., is used in America for paper pulp, and amongst other uses the European *P. tremula* is used for the same purpose. Poplar wood is used for box making, brake blocks, match-making, panelling, flooring, in the manufacture of carts and trucks, &c. The wood of some species splits well, and that of *P. tremula* is imported into the eastern counties for splitting up for the manufacture of baskets for fruit and flowers. Most of the poplars are fast-growing trees, and they might be grown more extensively than at present on wet land or about the banks of streams in the British Isles. Fast-growing hybrids such as *P. Eugenii*, Simon Louis, and *P. maryландica*, Bosc., are specially worthy of note. The wood can be sold at present for from 10d. to 14d. a cubic foot. Evidence of the value of poplar wood for packing cases is given in the United States America Forest Service Circular, No. 47, "Strength of Packing Boxes of Various Woods." For other information about poplar wood see *K.B.* 1911, p. 209.

Willow (*Salix* spp.).

BRITISH.—The best willow wood is grown in the British Isles, and a considerable quantity of Willow Rods for basket making is also grown. But in 1913 the imports of Willow Rods from foreign countries were valued at £94,274. The imports were from the following countries:—

	£
Germany	34,246
Netherlands	19,569
Belgium	12,288
Other Foreign Countries	28,171

All the rods required by British manufacturers might easily be grown in the British Isles if proper cultural methods were adopted. A Circular on "The Cultivation of Willow Rods and their Preparation for Market," is published by the Board of Agriculture and Fisheries. The wood of *Salix coerulea*, Sm., is used largely for the manufacture of cricket bats and artificial limbs. It is grown almost exclusively in the British Isles.

Oak (*Quercus* spp.).

British.—British Isles, Canada. Foreign.—Russia, Germany, Austria-Hungary, Japan (including Formosa), U.S. America.

The imports for 1913 amounted to 254,836 loads, valued at £1,736,061. More oak might be grown at home.

Maple, Sycamore (*Acer* spp.).

British.—Canada, and grown in the British Isles. Foreign.—N. United States of America and probably various European countries.

The wood is used for floor blocks, furniture, inlaying, panelling, cabinet work, rollers for washing machines, kitchen and dairy utensils, &c. The best British grown Sycamore realised 2/6 a cubic foot before the war, and is probably worth more now. Information on American Maples is given in *K.B.* 1911, p. 303.

Ash (*Fraxinus* spp.).

British.—British Isles, Canada. Foreign.—United States of America, Hungary, Japan, Manchuria.

Good ash timber is always in demand and commands a good price. It is used for many purposes where strength and elasticity are required. Some of its uses are spokes and felloes of wheels, tool handles, shafts of carts and other vehicles, parts of railway carriages and trucks, agricultural implements, and parts of aeroplanes. The best English Ash (*Fraxinus excelsior*, L.) is that from young, clean, and fairly fast-grown trees. Such wood commands from 2/6 to 3/- a cubic foot as it stands. A great deal more might be grown in the British Isles than is the case at present. Hickory is perhaps the best substitute for ash. For particulars regarding American Ash see *K.B.* 1911, p. 217.

Birch (*Betula* spp.).

British.—British Isles, Canada. Foreign.—Finland, Sweden, Prussia, United States of America.

This wood is used extensively for furniture, box making, shuttles, bobbins, plywood, tea chests, and other purposes. The wood grown in the British Isles is of inferior quality to that imported, but with improved methods of cultivation there is no reason why the quality should not be improved, so that it would compare favourably with the foreign product. Heavy railway freight and the absence of proper marketing facilities appear to have discouraged many owners of woodlands in the proper cultivation of trees for the production of timber. Information upon various birches is given in *K.B.* 1911, p. 221.

Elm (*Ulmus* spp.).

British.—British Isles, Canada. Foreign.—Holland, Germany, United States of America.

Elm wood is used largely for hubs of wheels, chair bottoms, cart building, barrows, boat building, coffins, and other purposes.

English Elm is often low priced on account of much of the timber being hedge or park grown and rough, but it also suffers in comparison with imported wood from the latter being imported cheaply and partly worked. Elm of the very best quality is however, grown in the British Isles, and a great deal more could be produced.

Beech (*Fagus* spp.).

BRITISH.—British Isles, Canada. FOREIGN.—Germany and other European countries, United States of America.

Beech is one of the most generally useful of hard woods. Timber of the very best quality is grown in the British Isles, particularly on chalky soils, and it is probable that all the required wood could be grown in the country. It is used extensively for chair making; is one of the most popular of woods for the backs of brushes, is largely used for the panels of pianos and other articles, whilst it is used for innumerable small articles such as children's hoops, malt shovels, butchers' trays, bowls, spoons, spades, &c. Wood of *Nothofagus* spp., from S. Chile, could be used for some of the same purposes. For other information upon beech wood see *K.B.* 1911, p. 109.

Spanish or Sweet Chestnut (*Castanea sativa*, Mill.).

BRITISH.—British Isles. FOREIGN.—France, Spain, Corsica, United States of America.

The wood is very much like Oak in appearance, and can be substituted for it for many purposes. It is used extensively for heavy building work, fences, and in some places for pit props. Tannin is extracted from the wood in Corsica. The wood of trees below 50 years of age is usually the most valuable when grown in the British Isles, for the wood of older trees is often badly injured by ring shake.

Lime, Linden, Basswood (*Tilia* spp.).

BRITISH.—British Isles. FOREIGN.—United States of America.

The wood is used for sounding boards of musical instruments, carving, turnery, and for kitchen and dairy requisites.

Cherry (*Prunus* spp.)

BRITISH.—British Isles. FOREIGN.—United States of America.

Cherry wood was at one time in great demand for the manufacture of furniture, but it has now been largely displaced by birch, mainly by reason of a regular supply not being forthcoming. If cherry wood were more extensively grown there is reason to suppose that it would again become popular. Much of that at present marketed is used for turnery. Young straight sticks are in demand for walking sticks and umbrella handles, whilst a certain quantity of wood is required annually for tobacco pipes. Information regarding American cherry wood is given in *K.B.* 1911, p. 218.

Box (*Buxus* spp.).

British.—British Isles, South Africa. Foreign.—Caucasus, Asiatic Turkey.

The wood is used for engraving, the manufacture of mathematical instruments, and other purposes for which non-shrinking wood is necessary. Most of the best wood has been imported from the neighbourhood of the Black Sea, but *Buxus Macowani*, Oliv., from S. Africa, also supplies a good timber. Box wood has also been received from Madagascar. Substitutes for Box wood are *Casearia praecox*, known as West Indian or Venezuelan Box wood (see *K.B.*, 1914, p. 214), and Knysna Box wood (*Gonioma Kamassi*, G. Mey.) (see Board of Trade Journal, April 8, 1915, p. 69). From that report wood valued at £3,196 was exported in 1913, mainly to Germany, where it is understood to have been used for the manufacture of shuttles, bobbins, &c. This wood is said to be suitable for engraving.

Walnut (*Juglans* spp.).

British.—British Isles. Foreign.—France, Asia Minor, Persia, N. America.

Used largely as a furniture wood and for gunstocks. *J. regia*, L., is the common species of Europe and W. Asia and *J. nigra*, L., of N. America. The wood is always valuable. Walnut timber may also be obtained from Japan. There are several spurious walnut woods. For information upon American walnut wood see *K.B.* 1911, p. 215.

Yellow Poplar, Canary Whitewood, Basswood (*Liriodendron Tulipifera*, L.).

Foreign.—Eastern United States.

A very useful wood imported into the United Kingdom in quantity and used for furniture and many indoor purposes, often as a substitute for Yellow Deal. Would give good results as a forest tree in the South of England. See also *K.B.* 1911, p. 214.

Hickory (*Carya* spp.).

Foreign.—Eastern United States of America.

The wood is strong, with great elasticity, and is largely used for carriage building, spokes, tool handles, and other purposes for which ash is used. It can be used in place of ash for many kinds of work. The various hickories are dealt with in *K.B.* 1911, p. 304.

Locust or False Acacia (*Robinia Pseudacacia*, L.).

Foreign.—Eastern United States of America, France, and other European countries.

The wood is very strong and durable, lasting well in contact with the ground. On this account it is very valuable for posts, and is used largely for that purpose in America. On the Continent it is grown as coppice for stakes, vine poles, &c. It might

be grown more widely in the British Isles for posts, &c. Trees up to 40 or 50 years of age would probably be more useful than older trees. See also *K.B.* 1911, p. 219.

Persimmon (*Diospyros virginiana*, L.).

Foreign.—Eastern N. America.

The wood is used extensively for weaving shuttles and bobbins, and is said to make a good substitute for box.

Greenheart (*Nectandra Rodioei*, Schk.).

British.—British Guiana. Foreign.—Brazil.

The timber is very hard and durable. It is highly esteemed for use in brackish water, and is perhaps the most widely used timber for piles for wharves, dock gates, &c. It is also a favourite wood for fishing rods. The wood of the Bullet Tree (*Mimusops globosa*, Gaertn.) is said to be sometimes used as a substitute, also the wood of Quebracho Colorado (*Quebrachia Lorentzii*, Griseb.).

Satin Walnut (*Liquidambar styraciflua*, L.).

Foreign.—United States of America.

This wood is used extensively in the manufacture of the cheaper kinds of bedroom furniture. It has also been used for paving blocks, but warps badly in seasoning, and is worthless for the purpose.

Quebracho (*Quebrachia Lorentzii*, Griseb.).

Foreign.—Argentine Republic.

The wood is very strong and durable. It is used for heavy building work, sleepers, piles, dock timber, and can be substituted for Greenheart. Tanning material and dye are extracted from the wood.

Seeds have recently been sent from Kew to several British Colonies.

Mahogany (*Swietenia Mahagoni*, L., *S. macrophylla*, King, and *Khaya* spp.).

British.—West Coast of Africa. Foreign.—U.S. America, Cuba, Hayti, San Domingo. In 1913, 80,995 tons of mahogany, valued at £666,297, were imported from the following foreign countries: Germany, German West Africa, French West Africa, United States of America, Cuba, Hayti, and San Domingo. From the following British Possessions 60,806 tons, valued at £559,582, were imported: British West Africa, Gold Coast, Southern Nigeria, British West Indies, British Honduras. The mahogany from West Africa is usually the timber of species of *Khaya*, and although it is generally inferior in beauty and value to the wood of *Swietenia Mahagoni*, it makes handsome furniture and shop fittings, and is valuable for panelling, &c. There appears to be room for an increase in the trade of West African woods generally. For other African Mahoganies see *Kew Bull.* Add. Ser. ix. part i.

Mangrove (*Rhizophora Mangle*, L., and *R. mucronata*, Lam.).

Widely distributed on low-lying land about the coast line of many tropical countries.

The wood is rich in tanning matter, and an extract is sometimes used for tanning leather. An attempt has been made to popularise the wood for sleepers and paving blocks. It is likely, however, that it may have a better future for pit props. Large quantities can be obtained from the tropical coast of Africa.

West Indian Locust (*Hymenaea Courbaril*, L.).

British.—British Guiana. Foreign.—Brazil.

A hard, tough, and close-grained wood, useful for building purposes and for furniture.

Ebony (*Diospyros Ebenum*, Koenig).

British.—Southern India and Ceylon.

The wood is used for furniture, cabinet work, turnery, piano keys, &c., but is becoming scarce. Substitutes are *D. mespiliformis*, Hochst., from West Africa, and West Indian Ebony (*Brya Ebenus*, DC.), a small tree with dark brown or black heartwood, which takes a high polish.

Other species of *Diospyros* that are useful furniture woods are *D. quaesita* (Calamander or Coromandel Wood), from Ceylon, and *D. Kurzii*, Hiern. (Andaman Marble or Zebra Wood), from the Andaman and Nicobar Islands. In both cases the wood is peculiarly streaked with yellow and black.

West Indian Cedar (*Cedrela odorata*, L.).

British.—West Indies. Foreign.—Northern parts of S. America.

The wood is more popular than any other for the manufacture of cigar boxes. It is probable that this tree would grow well in various parts of West Africa. See also *K.B.* 1913, p. 210.

Red Cedar, Moulmein Cedar (*Cedrela Toona*, Roxb.).

British.—India, Burma, Queensland, New South Wales.

A valuable furniture and cabinet wood, useful for carving, &c. For other Cedars see *K.B.* 1913, pp. 207-224.

Teak (*Tectona grandis*, L.).

British.—Burma, India (cultivated). Foreign.—Java, Siam.

From British India and other British Possessions 38,049 tons, valued at £711,676, were imported in 1913, and from Java, Siam, and other Foreign Countries 9723 tons, valued at £167,578, were imported into the British Isles during the same period.

Teak is cultivated in India, Southern Nigeria, and Togoland, but the supply does not appear to equal the demand; therefore further attention to cultivation seems desirable. The teak plantations in West Africa have not yet reached a marketable age. Substitutes for teak have been suggested, the commonest being

Dipterocarpus tuberculatus, Roxb., and other species of the same genus, the timber of which is known as "Eng," "Yang Teak," &c. This wood is imported from Burma. See *K.B.* Add. Ser. ix. part iii. p. 519.

Jarrah (*Eucalyptus marginata*, Sm.).

British.—Western Australia.

A very hard, heavy, and durable wood of a rich red colour. It is used for paving blocks, counter tops, piling and quay work, sleepers, fences, and other purposes. Posts inserted in the ground have a very long life. For other particulars see *K.B.* 1897, p. 219.

Karri (*Eucalyptus diversicolor*, F. Muell.).

British.—Western Australia.

Used for purposes similar to those of Jarrah.

Blue Gum (*Eucalyptus Globulus*, Lab.).

British.—Tasmania.

The timber is used for heavy building work, as it is very strong and durable, and can be procured in large sizes. This tree and other species of *Eucalyptus* are used for forest planting in S. Africa, British Central Africa, New Zealand, and other countries, but they are too tender for general culture in the British Isles. Further particulars are given in *K.B.* 1903, p. 1.

XXVIII.—MISCELLANEOUS NOTE.

Ceylon Agricultural Leaflets.—A new series of leaflets is being issued by the Department of Agriculture, Ceylon. They are illustrated, quarto in size, and are signed by the writers who are experts in their respective subjects.

No. 3 deals with the Fluted Scale, one of the most beautiful and conspicuous of all scale insects, and No. 2 with Black Rot of Tea. The latter, described by T. Petch, is caused by the sterile mycelium of a species of *Hypochnus*. It is of special interest in that it is a new disease which has apparently only quite recently spread from the jungle to the tea plant. The Shot-hole Borer of Tea, which also attacks several of the plants used for green manuring, is described and illustrated in Leaflet No. 4. Leaflet No. 5 deals with the cultivation of food products, vegetables, and curry stuffs, and should serve to encourage the local cultivation of these products which is so necessary at the present time. The leaflets should prove of considerable practical value.

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ROYAL BOTANIC GARDENS, KEW.

BULLETIN

OF

MISCELLANEOUS INFORMATION.

Nos. 9 & 10] [1917

XXIX.—THE FLORA OF THE SOMME BATTLEFIELD.

The ground over which the Battle of the Somme was fought in the late summer and autumn of 1916 rises gradually towards Bapaume, and at the same time is gently undulating with some well-marked branching valleys initiating the drainage system of the area. Before the war the land was for the most part under cultivation, but on the highest levels there were large areas of woodland such as High Wood and Delville Wood, now shattered and destroyed, which will live as famous names in history.

The Butte of Warlencourt, reduced by bombardment to a bare mound of chalk, is seen by the remnants of stumps to have been covered with trees, and was no doubt just such a feature in the landscape as Barbury Camp or other clumps of trees on our English downs. Many an obscure village—and they were fairly numerous—has become immortal, but there is scarcely anything left to mark their site.

Villages, roads, open country, and woodland have been destroyed and ploughed up again and again by shells, with the result that hardly a level spot can be found. The surface of the ground is everywhere more or less deeply pitted by shell-holes of varying size and depth, and can best be imitated by arranging innumerable cups and basins as closely together as possible so that their rims shall reach a general level. It is only on the rims of the shell-holes that walking is possible.

During last winter and spring all this country was a dreary waste of mud and water, the shell-holes being so well puddled that the water has remained in them, and even in the height of the summer there were innumerable ponds, more or less permanent, in every direction.

The underlying rock is everywhere chalk with a covering of loam of varying thickness. As a result of the bombardment the old surface soil has been scattered and the chalk partially exposed. One effect of the shelling, however, has been to disintegrate the underlying chalk and produce a weathering effect which has been accentuated by the winter rains, snow and frost. A general mixing of chalk, subsoil, and scattered top soil and also a rounding of the sharp edges has taken place, so that

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instead of the new surface soil being sterile, the shelling and weathering have "cultivated" the land. That this is so is proved by the appearance of the Somme battlefield during the past summer.

Looking over the devastated country from the Bapaume Road one saw only a vast expanse of weeds of cultivation which so completely covered the ground and dominated the landscape that all appeared to be a level surface. In July poppies predominated, and the sheet of colour as far as the eye could see was superb; a blaze of scarlet unbroken by tree or hedgerow. Here and there long stretches of chamomile (*Matricaria Chamomilla*, L.) broke into the prevailing red and monopolised some acres; and large patches of yellow charlock were also conspicuous, but in the general effect no other plants were noticeable, though a closer inspection revealed the presence of most of the common weeds of cultivation, a list of which is given below.

Charlock not only occurred in broad patches, but was also fairly uniformly distributed, though masked by the taller poppies. Numerous small patches were, however, conspicuous, and these usually marked the more recently dug graves of men buried where they had fallen. No more moving sight can be imagined that this great expanse of open country gorgeous in its display of colour, dotted over with the half hidden white crosses of the dead. In no British military cemetery, large or small, however beautiful or impressive it may be, can the same sentiments be evoked or feelings be so deeply stirred. Nowhere, I imagine, can the magnitude of the struggle be better appreciated than in this peaceful poppy-covered battlefield hallowed by its many scattered crosses.

The woodland areas afford a striking contrast and are a melancholy sight, being a collection of battered and burnt stumps. Sometimes the bare gaunt trunks, showing here and there the stump of a lateral branch, are as much as 20 ft. high, but for the most part they are shattered, torn, and splintered with only a few feet of the bole remaining. In all the woods where the fighting was most severe not a tree is left alive, and the trunks which still stand are riddled with shrapnel and bullets and torn by fragments of shell, while here and there unexploded shells may still be seen embedded in the stems. Aveluy Wood, however, affords another example of the effort being made by Nature to beautify the general scene of desolation. Here some of the trees are still alive though badly broken, but the ground beneath is covered with a dense growth of the Rose-bay Willow Herb (*Epilobium angustifolium*) extending over several acres. Seen from across the valley this great sheet of rosy-pink was a most striking object, and the shattered and broken trees rising out of it looked less forlorn than elsewhere.

A little further back the woods have naturally suffered less severely, and trees that are badly torn and broken gradually become rare. Very occasionally, even in the battle area, a tree in leaf and only slightly injured may be seen, all the more pathetic and mournful in its loneliness especially when surrounded by gaunt and blackened stems, whose shattered, arm-like branches seem to be pointing with the hand of fate.

The roadside trees in the battle area have been equally destroyed, and in many cases they have been deliberately felled. It was interesting to notice that in a few cases the battered trunks were sprouting both from the stem and from the base, and in almost every case the sprouting trees were elms; very rarely were signs of life shown by poplars.

The innumerable shell-hole ponds present many interesting features to the biologist. In July they were half full of water, and abounded in water beetles and other familiar pond creatures, with dragon flies flitting around. In nearly every shell-hole examined, just above the water level, was a band of the annual rush (*Juncus bufonius*, var. *gracilis*), and this plant appeared to be confined to these annular bands where the ground was relatively moist, and to occur nowhere else. With the *Juncus*, and often growing out of the water, were stout plants of Persicaria (*Polygonum Persicaria*) and water grasses, not in flower, were often seen spreading their leaves over the surface of the pools.

In the battlefield area not only were the common cornfield weeds to be seen, but here and there patches of oats and barley, and occasionally plants of wheat, sometimes apparently definitely sown, perhaps by the Germans, though more often the plants must have grown from self-sown seeds of crops that were on the land before the war. Here and there, too, could be seen opium poppies representing former cultivation and remnants of battered currant and other bushes which alone remained to show where once had been a cottage garden. Both weeds and corn afford good evidence that the soil has not been rendered sterile by the heavy shelling, but how and when the land can be brought into a fit state for cultivation are questions not easily answered. Even were the ground not full of unexploded shells, barbed wire and every sort of obstruction, the levelling of the surface would present an immense problem.

Weathering in course of time will tend to fill the shell-holes and smooth down the separating ridges, but even then ploughing by any ordinary machine would appear to be impossible, and the only solution of the problem may be to convert the battlefield into a forest tract by planting trees as soon as conditions allow, thus forming a "Via Sacra," both beautiful and useful.

The re-surveying of the country and re-apportioning of the devastated land in former villages and open fields, though simple on a map, must for some time be quite impracticable.

One other feature of the flora of this region deserves mention, namely, that of the banks and sides of the roads. In such places traces of the old permanent flora still remain, and perennial plants, such as the purple Scabious (*Scabiosa arvensis*), prickly Eryngium (*Eryngium campestre*), yellow bedstraw (*Galium verum*), Chicory, Hard-heads (*Centaurea Scabiosa*), the dwarf thistle (*Cnicus acaulis*), and other characteristic chalk plants were occasionally seen.

The clothing of this large tract of country with such a mass of vegetation composed almost entirely of common annual cornfield weeds is remarkable when one remembers that it has been the seat of encampments, and has for the most part been out of cultivation since the autumn of 1914. It is well nigh impossible

that such masses of seed can have been carried by wind or birds to cover these thousands of acres, and the plants must therefore have grown from seed lying dormant in the ground. No doubt in the ordinary operations of ploughing and tilling of the ground in years before the war much seed was buried which has been brought to the surface by the shelling of the ground and subsequent weathering. In this connection the presence of charlock on the more recently dug graves, where the chalk now forms the actual surface, is of interest, since it adds further proof of the longevity of this seed when well buried in the soil.

Further north towards Arras, where the soil is deeper, docks, thistles, and a more permanent wild vegetation predominate, giving a dreary and derelict effect in comparison with the splendour and magnificence of the chalky slopes of the Somme battlefield.

List of Plants.

The following is a list of plants observed on two brief visits to this area. A few common docks and thistles occurred in places, otherwise the vegetation was almost entirely composed of annuals; grasses of various kinds were also present, in addition to scattered plants and patches of cereals, but the species were not definitely determined.

Papaver Rhoeas, L., poppy.
Fumaria officinalis, L., fumitory.
Raphanus Raphanistrum, L., white charlock.
Brassica Sinapis, Vis., yellow charlock.
Matricaria Chamomilla, L., chamomile.
Centaurea Cyanus, L., cornflower.
Cnicus arvensis, Hoffm., thistle.
Sonchus arvensis, L., corn sowthistle.
Sonchus oleraceus, L., sowthistle.
Specularia Speculum, A. DC., looking-glass flower,
Anagallis arvensis, L., scarlet pimpernel.
Myosotis arvensis, Hoffm., forget-me-not.
Convolvulus arvensis, L., small bindweed.
Solanum nigrum, L., nightshade.
Plantago major, L. and other species, plantain.
Veronica hederaefolia, L. and other species, speedwell.
Galeopsis Ladanum, L., hemp-nettle.
Chenopodium album, L., goosefoot.
Atriplex patula, L., orache.
Polygonum aviculare, L., knotgrass.
Polygonum Persicaria, L., persicaria.
Rumex obtusifolius, L., dock.
Euphorbia Helioscopia, L., sun spurge.
Mercurialis annua, L., dog's mercury.
Juncus bufonius, L., var. *gracilis*, St. Amand, rush.

A few grasses and occasional plants or patches of oats, barley, and wheat.

A. W. H.

XXX.—THE HIMALAYAN SPECIES OF SKIMMIA.

J. S. Gamble.

For some years I have been under the impression that the plant described in the Flora of British India I. p. 499 (1875) as *Skimmia Laureola* contained more than one species, because, in addition to the well-known undershrub of the Western Himalaya, barely 2-3 ft. high with pale yellow flowers and red berries, I found in the Eastern Himalaya one which grew into a small tree and had nearly white flowers and black berries, while at high levels also in the Eastern Himalaya there seemed to be a third, a quite low trailing shrub also with whitish flowers and (so far as I know) greenish rather dry berries. I have for a long time intended to find out more about these plants and I have now been induced to go into the question by having received from Mr. C. C. Lacaita, F.L.S., who made an expedition to the mountains of Sikkim in 1913, with the request to name them, specimens of those he collected on his tour. I have now gone through the whole of the material in the Herbarium at Kew and compared with it Mr. Lacaita's specimens as well as those which I myself collected at various times when on forest work both in the Western and Eastern Himalaya.

Apparently, the first specimens collected were those obtained by Wallich in Nepal in 1821 and issued as Cat. 6357A. It would seem that it was on these specimens that De Candolle in 1824 based his *Limonia? Laureola*, DC. Prodr. i. p. 536. The description is very brief, "foliis simplicibus, floribus terminalibus corymboso-capitatis. Folia exacte *Daphnes Laureolae*. Calyx 5-partitus. Petala et stamina 5." De Candolle's description was followed in 1832 by the very full one of Wallich himself with plate quoted as *Limonia Laureola*, Wall. in Pl. As. Rar. p. 23, t. 245 (1832). The plate gives an excellent representation of the flowering stage of the common species of the Western Himalaya, except that the leaves are shorter and not so oblanceolate as in most of the specimens I have seen either wild or in gardens or as Herbarium specimens. Still, I cannot doubt that Wallich's figure is intended to represent the Western Himalayan plant with pale yellow flowers and dense short terminal flowering panicles. The leaves are given as 3-5 in. long which is correct, and the chief point of discrepancy in the description is that the fruits are described as being almost as large as those of the olive which is a larger size than suits any of the Himalayan Skimmias. The specimens quoted in Wallich's description are (1) his own from Nepal, apparently Cat. 6357A, collected in 1821, (2) specimens collected by Dr. G. Govan in Sirmore, probably Wall. Cat. 6357B, and (3) specimens collected by Blinkworth in Kumaon which I have not seen.

The next description is that by Decaisne in Jacquemont's "Voyage Botanique," quoted *Anquetilia Laureola*, Dcne. in Jacq. Voy. Bot. p. 161, t. 161 (1844). He describes a shrub about a metre high, the stems erect, rooting below and with ashy bark; leaves 10 cm. long. 2-2·5 cm. broad, oblong lanceo-

late; flowers pale yellow in a densely-flowered panicle; berry red; and his description and figure clearly represent the West Himalayan plant. The specimens were collected at high elevations in the "Pir Panjal between Ilahabad and Haiderabad."

The same plant is referred to in Roemer's Synopsis as *Laureola fragrans*, Roem. Syn. I. 74 (1846), and it was then transferred to *Skimmia* as *Skimmia Laureola*, Sieb. & Zucc., MSS. in Walp. Rep. V. p. 405 (1845-46). This seems to have been overlooked by Sir Joseph Hooker, who gives it as *Skimmia Laureola*, Hook. f. in Fl. Br. Ind. I. p. 499 (1875). Sir Joseph had before him, belonging to Indian species of *Skimmia*, not only the specimens from the West and Central (Nepal) Himalaya referred to by previous authors, but also specimens from the Eastern Himalaya collected even so far to the east as the Mishmi Hills and also in the Khasia mountains of Assam. I have carefully examined all the available material, and so far as I can make out the plant described and figured by Wallich and Decaisne has only been collected in the Western Himalaya. All the material from the Eastern Himalaya is distinct from that of the Western region and falls in my opinion into two sections:—(1) A small tree or large shrub with thick woody stem, white or greenish-white flowers in terminal panicles 2 in. or more long, oblong or oblanceolate leaves up to 8 in. long, long acuminate at apex, rather thin, prominently nerved and with long petioles, and black berries found at elevations of about 6000 to 8000 ft., and (2) a very low, rather trailing bush, the stem rooting below, leaves at most 2·5 in. long with prominent midrib and obscure nerves, flowers in rather few-flowered often axillary panicles apparently white and small greenish berries. No. (1) was recognised by Dr. T. Anderson in a note on his sheet in the Kew Herbarium "No. 51, 6500 ft. alt., May, 1862, as a species *Skimmia arborescens*, T. And., but it was apparently never published. No. (2) was apparently recognised by Sir Joseph Hooker as a species and called *S. Wallichii*, Hook. f. & Thoms. on a sheet of Wallich's collected in Nepal in 1821. This name also does not appear to have been published. The specimens in the Kew Herbarium show the much more open and fewer-flowered inflorescence and the acute to caudate-acuminate small leaves with short petioles and conspicuously keeled midrib. It was also collected by Hooker himself in Sikkim (No. 94 Tonglo top, 10,000 ft.; Singalilah 11,000 ft.; Lachoong 9000 ft.); and by Griffith in Bhutan (Nos. 1810, 1811). I have given diagnoses of the characters of these two East Himalayan species in a note appended to a paper by Mr. C. C. Lacaita in the Linnean Society's Journal, vol. xliii. p. 491.

Part iv. of the "Plantae Wilsonianae" appeared in 1914 with Rehder & Wilson's description of the Western China Skimmias, two species (1) *S. melanocarpa*, under which was quoted, besides Chinese specimens, Sir Joseph Hooker's Sikkim plant which I have above referred to as *S. arborescens*, T. And. MS., and (2) *S. Fortunei*, Mast. At the suggestion of Mr. C. C. Lacaita. I have again looked up the specimens at Kew and am glad to find that most of Wilson's numbers have been received and incorporated. The type of *S. melanocarpa* is *Wilson* 1054,

a small shrub with rather small leaves which, in my opinion, is not *S. arborescens*, T. And., but, if anything, is nearer *S. Wallichii*, Hook., f. & Thoms. Of the other numbers of Wilson's and Henry's specimens quoted, *Henry* 10469, 11200, 11069, also but not quoted 10546, 11426, 13328 belong to a large shrub with larger leaves and black fruit which probably really is *S. arborescens*, T. And. In Rehder and Wilson's description, *S. melanocarpa* is described as "0·3-1 m. altus," but in brackets they have added "planta yunnanensis interdum ad 5 m. secundum Cl. Henry." The statement in brackets refers to the *Henry* numbers above quoted, which I believe to belong to *S. arborescens*. It seems clear to me, now, that the Sikkim plant is *not* the type *melanocarpa*, but should continue to bear Anderson's name. So that, in my opinion, Rehder and Wilson's *S. melanocarpa* includes two species, a thin small-leaved low shrub which is real *S. melanocarpa* and which seems not to occur in the Himalaya, and the large big-leaved shrub of Yunnan which is probably the E. Himalayan *S. arborescens*.

XXXI.—NATURAL GRAFTING OF BRANCHES AND ROOTS.

W. Dallimore.

(With Plates.)

Natural grafting of branches and roots is of common occurrence amongst certain species of trees and shrubs, and the results are sometimes very curious, not only by reason of the complicated character of the unions between branches or roots of individual trees, but also by the joining together of large branches and even trunks of different trees of the same species.

Naturally-grafted branches are fairly common on beech, oak, holly, lime, willow, yew, and Scots pine, whilst they may also be noted on many other trees. The commonest form of natural grafting is that which results from the crossing of two branches. When young and light such branches are easily moved by wind, and the friction thus caused injures the bark, first by polishing the surface, afterwards by fracture. Later on the wood may also be injured, for, as the branches grow older and heavier, the easy, gliding action of one branch upon the other gradually gives place to a slower but more injurious grinding movement which may cause considerable injury and deformity, the affected surfaces losing their roundness and one or both branches becoming worn to a mere shell. During the whole of the time, however, nature is trying to repair the injury and patches of callus are formed on both branches at those points where friction is least active. As the branches become heavier and movement ceases the patches of callus grow together and eventually a strong union is effected between the two branches. A series of specimens in the Forestry Museum at Kew show quite well how such a union is brought about.

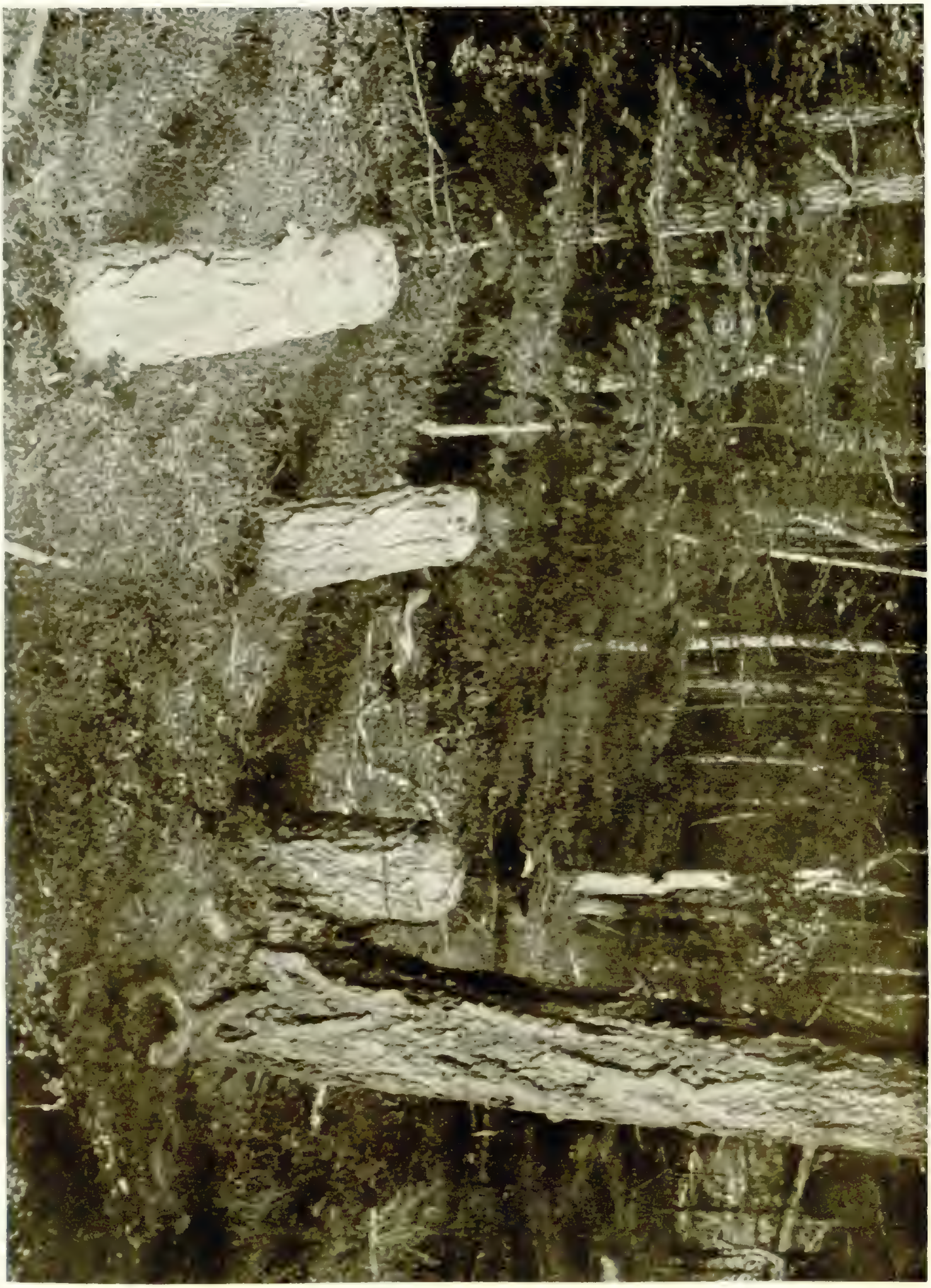
Another fairly common method of natural grafting of branches

is brought about by a side branch from a principal branch or from the leading shoot of a tree growing against another branch or a rival leader. In such a case there may not be sufficient friction to seriously injure the bark, but there may be considerable pressure and the small branch may cause a certain amount of constriction to the larger one in the same way that tightly tied string or wire does, except that the pressure is on one side only. The bark above and below, therefore, grows faster than the constricted part, with the result that the small branch is gradually overgrown in the same way that a string or wire may be completely buried in the wood, or a stone pressed tightly against the bark of a young tree may be overgrown. But in other cases there may be enough friction to injure the bark and expose the cambium. Then a union is brought about by fusion of callus formed at the point of injury. In either case it is easy to see in the early stages what has happened, but later on the end of the small branch may die and fall away, the point of union being completely overgrown by the main branch. As a result there is a small branch, to all appearances alive and healthy, perhaps from a few inches to several feet long, uniting two branches or two trunks in such a way that it is difficult to decide from which branch the connection originated. A few years ago, when visiting Scotland, I was shown two large Scots pines standing a few feet apart which were united by such a branch at a point 12-15 feet from the ground, the connecting branch being almost horizontal and appearing to grow from about the centre of each trunk. Two beech trees are joined in the same way on the Ashridge Estate, Berkhampstead, and a photograph has been recently received from British Columbia showing two trees connected by a branch at a considerable distance from the ground.

A curious instance of natural grafting of beech may be seen in the Forestry Museum at Kew. A small side branch after growing for about 8 inches, crossed the parent branch and became united. The end of the small branch died and no trace of grafting can now be seen on the bark. At its greatest distance from the parent branch it is $1\frac{1}{4}$ inches, thus forming a handle by which the specimen can be conveniently carried. Modifications of this style of natural grafting may often be noticed and a branchlet may grow several feet away from the parent branch and then gradually return and join again at a point higher up the branch.

Natural grafting is also effected by a branch growing through the acute angle formed by two fairly erect branches. In such a position there is little movement and the small branch is soon overgrown by the large ones.

A transverse section of timber may show two or even three or more hearts. This may be due to the union of a secondary leader with the true leader, or several leaders may become involved, but it does not appear to hold good in every case. In some instances the appearance of the timber suggests that the union of two or more shoots has been complete from infancy. In elm trees two or more hearts may often be found in a section of the timber especially if the section is taken from a point



[*To face page* 304.

II.

III.

higher than the middle of the trunk. Several hearts are often found in a transverse section of yew wood. In yew, however, the condition is usually due to erect stems formed at the base of the main trunk being overgrown by the trunk, but now and then natural grafting is in evidence.

Whenever a large tree is felled, evidence of root grafting is found, for, as the roots of trees growing close together become intermixed with those of the same species, and sometimes of allied species, they easily unite. Pressure is probably responsible in most cases for root grafting, and very curious results are sometimes seen, although, obviously, grafted roots attract less notice than grafted branches. Roots growing amongst close gravel or in clay and chalk often present a very curious appearance not only by intergrafting, but by deformity caused by the rough edges of stones and by their growing round and enclosing stones.

Whether trees actually benefit to any great extent from this natural intergrafting of roots or branches is doubtful, for there can be no discrimination of stocks and scions which makes propagation by grafting of such importance to the horticulturist, but that some local benefit may result is seen occasionally, more particularly by a branch of a weak or unhealthy tree which has become united to a healthy tree, being more vigorous than the other branches.

An interesting series of photographs, three of which are published with this article, has recently been received at Kew from Private C. C. Pemberton, of Victoria, British Columbia, now with the Canadian Army. They represent a series of studies in the natural grafting of roots and branches as seen in the forests of British Columbia, together with other interesting conditions of tree growth. The branch grafts are varied in character, but similar ones are of fairly frequent occurrence. Amongst the root grafts, however, a particularly interesting condition is represented. This is the healing under certain circumstances of the cut surfaces of Douglas fir and *Abies grandis* stumps when cut over at a height of 1-2 feet above the ground. Mr. Pemberton makes no pretence to sylvicultural or botanical knowledge, his observations having been conducted solely by reason of his love of nature. The healing of branchless stumps appealed to him as being something apart from the ordinary behaviour of trees, and he set to work to find a reason. By baring the tree roots over a considerable area of ground he was able to satisfy himself that every stump that had healed or was well advanced towards that state was attached by root grafting to a standing tree with healthy foliage, and further, that by cutting down the living tree the stumps were killed within a short time. He noticed further that the roots of decaying or dead stumps were rarely attached to the roots of a living tree.

The phenomenon has been previously noticed and is referred to by Sorauer, Handbuch der Pflanzenkrankheiten, Berlin, 3rd ed., 1909, vol. i. p. 774. The views there expressed coincide largely with the observations made by Mr. Pemberton, for the theory is favoured that the healed stumps obtain nourishment

by means of the concrescence of their roots with strong roots of neighbouring trees which still possess a trunk and crown. The author, however, does not consider that this is always so, for he instances cases of healed stumps standing too far away from living trees for the roots to have any connection. To some extent he favours the idea of reserve material stored in cut over stumps accounting for the commencement of new growth, but once a callus is started he thinks that further growth may be stimulated by chlorophyll present in the cortex of the callus, more particularly when the stump is in a light and open position.

So far as Mr. Pemberton's observations go, however, and he has paid a good deal of attention to the subject, he has been unable to find a single instance of the healing of a stump that is unattached to the roots of a tree bearing healthy branches. Should he be able at some future time to extend his studies it would be interesting to learn whether he finds any other indication save natural grafting that would account for the phenomenon.

Natural grafting in its various phases holds peculiar attractions for people interested in tree life, and the subject is well worthy of attention by people who have the necessary time at their disposal.

EXPLANATION OF PLATES.

1. Healed stumps of Douglas fir (*Pseudotsuga Douglasii*).
2. Two trees of Douglas fir showing the connection of roots above ground.
3. Naturally-grafted roots of *Abies grandis*.

XXXII.—THE NATURE OF CHARRED WOOD.

L. A. BOODLE.

The blackening of organic matter by heat or by the action of sulphuric acid is generally described as carbonisation, and the use of this term implies the presence of free carbon in the blackened product. In wood-charcoal obtained by heating in the usual way, the percentage of carbon present varies with the temperature employed for charring. Thus it is stated that charcoal produced at 249° C. contains 65 per cent. of carbon, and that temperatures of 399° C. and 1499° C. give charcoals with 80 and 96 per cent. of carbon respectively. Ordinary charcoal is known to contain oxygen, hydrogen and a little nitrogen, besides carbon and the constituents of the ash. One might suppose, therefore, that the charcoal prepared at 249° contains free carbon, as well as a considerable proportion of some compound of carbon, hydrogen and oxygen, and that the blackness of the material depends on the presence of the free carbon.

Some experiments recently made with charred wood have a bearing on this subject, and, though they were quite simple and unaccompanied by any chemical analysis, they gave some suggestive results.

The material used in the experiments consisted of wood (in most cases Pine), charred either by sulphuric acid with heat, or by heat alone, and in both cases some variation was introduced into the conditions under which carbonisation took place. The black substance obtained was first powdered, and then each sample was submitted to two tests, namely, boiling for a short time in eau de Javelle, and boiling for two minutes in nitric acid (pure, 1·42), to which some chlorate of potash had been added. Samples of typical charcoal were also treated in the same way, and were found to be resistant to both these re-agents.

Treatment with sulphuric acid was carried out as follows:—A small piece of wood was soaked or boiled in diluted sulphuric acid (one part of the acid to six or ten parts of water), and the specimen, after its surface had been dried, was then heated in an oven.

In two experiments pieces of wood, which had been previously boiled in dilute sulphuric acid, were heated gradually to 160° and 200° C. respectively. The product in both cases was similar in appearance to ordinary charcoal, but was found to be soluble in the nitric acid re-agent.* Further, the substance obtained at 160° was soluble in eau de Javelle, except for a very small residue, while the specimen prepared at 200° was only slightly attacked by this re-agent. Blotting paper similarly treated became blackened, and behaved towards the re-agents in the same way as the charred wood.

Other experiments (without the use of sulphuric acid) were made to supplement the tests applied to typical charcoal. Wood was heated cautiously over a small flame, using either a small piece of wood on mica, covered by a watch-glass, or a thin layer of sawdust between two sheets of mica. Heating was stopped almost as soon as the wood became quite black, or was continued longer. In the latter case a typical charcoal was obtained, insoluble in the nitric re-agent, while less heating gave a product soluble in this re-agent, and probably corresponding to a low-temperature charcoal. Among the specimens obtained, those soluble in the nitric re-agent were either partially soluble in eau de Javelle, or were insoluble, according to the duration of the heating used to produce their carbonisation.

The foregoing data show that wood can be charred so as to give a product which differs from typical charcoal in its behaviour towards oxidising agents. Moreover, a series of degrees of resistance to these re-agents can be obtained, and evidently bears a relation to the severity of the charring process.†

It remains to be seen whether all "charcoal" produced at a relatively low temperature will be soluble in the nitric re-agent, and whether the series of "charcoals" prepared by heat alone can be completed by obtaining a specimen entirely soluble

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* In some cases the product was treated with ammonia and soaked in water, to remove the remaining sulphuric acid, before being tested with the two re-agents.

† Treatment with dilute sulphuric acid and heat owes its effect primarily to the concentration of the acid by the loss of water, but the action of the acid is apparently enhanced by heat at certain temperatures.

in eau de Javelle. The lack of a convenient arrangement for heating at the requisite range of fixed temperatures has postponed the necessary experiments.

The fact that certain specimens of charred wood are completely soluble in the nitric re-agent, and some even in eau de Javelle, leads to the conclusion that in such cases either no free carbon is present, or, if there is any uncombined carbon, it must be in a different state from that in which this element occurs in typical charcoal. The first of these assumptions appears the more probable, and it may be supposed that a "charcoal" soluble in these re-agents consists throughout (apart from ash, etc.) of a black organic compound of carbon, hydrogen and oxygen. It is suggested further that different stages of carbonisation may involve the production of at least two black organic compounds, one soluble in eau de Javelle, and one insoluble in it, but dissolved by the nitric re-agent. The more resistant substance would be derived from the other by a further loss of hydrogen and oxygen, and incomplete conversion into the more resistant compound would be indicated by *partial* solubility in eau de Javelle.

In the cases of partial solubility in eau de Javelle observed in the experiments mentioned above, the residue was black. Slighter charring with acid can, however, give a product in which there is apparently merely a fractional conversion of the woody tissue into a black compound. Thus in two experiments, pieces of wood treated with sulphuric acid were heated for one hour at 78° and 104° C. respectively. The first specimen was brownish-black, and not brittle, while the second was fairly similar to typical charcoal. The product in both cases was bleached by eau de Javelle, and was not largely soluble in this re-agent.

Useful advice on several points was kindly given by Dr. P. Haas, and is gratefully acknowledged.

XXXIII.—FUNGI EXOTICI: XXIII.

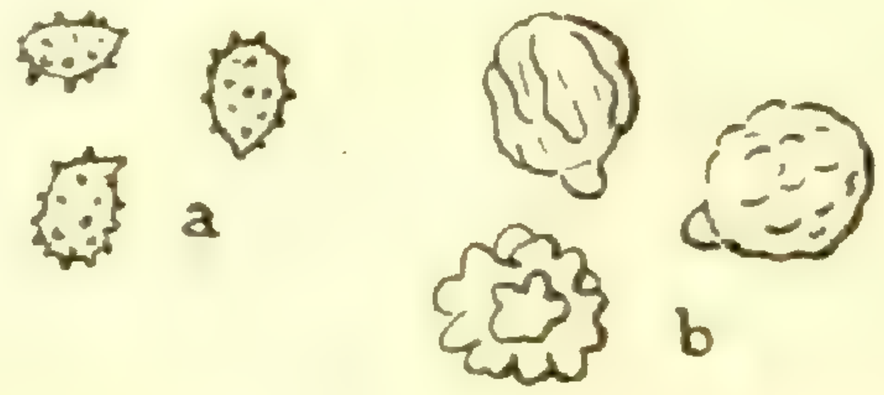
E. M. Wakefield.

The present contribution includes eight species of fungi which are either known to be parasites or are suspected of parasitism. Three of them, *Polyporus Coffeae*, *Helicobasidium longisporum*, and *Cercospora cannabina* occur on economic plants, and may prove to be of some importance. The parasitism of the two former is not proven, but it is possible that the *Helicobasidium*, at least, may be capable of causing some injury. Fortunately at present these are the only specimens which have been reported.

Polyporus Coffeae, *Wakef.*

Fungus mesopus. *Pileus* carnosus, irregularis, nunc lobatus nunc undulatus, vegeto cremeo-albidus, sicco alutaceus, adpresse subtomentosus, azonatus, ad 15 cm. diametro. *Contextus* concolor vel isabellinus, centro ad 3 cm. crassus, marginem versus

tenuior. *Tubuli* obscuriores, tenuissime tunicati, 2·5-7·5 mm. longi. *Pori* subhexagoni, 1-2 mm. diametro, sicco collapsi,



a. Basidiospores. b. Conidia from root of coffee tree. × 850.

sordide brunnei. *Stipes* excentricus, 5-8 cm. longus, basi 2-2·5 cm. crassus, sursum incrassatus. *Sporae* copiosae, stramineae, aculeatae, 5-6 × 4 μ (cum aculeis).

Tropical Africa. Uganda; at the roots of a dead Coffee tree, Kampala, *W. Small* 327 (1915).

The fungus belongs to the section *Spongiosus* of *Polyporus*, and is near to *P. rufescens*, from which it is distinguished by its larger size and aculeate spores. It is under suspicion of having caused the death of the tree. The fructifications were found surrounding the collar of the plant, the roots of which were encrusted with a layer of white mycelium mixed with sand. On this crust of mycelium there occur patches of a conidial fructification which may be connected with the *Polyporus*. The conidial layer is chestnut-brown, pulverulent. The conidia are stalked, subglobose, sometimes with a hyaline apiculus at the apex, coarsely warted, the warts arranged more or less in lines running from apex to base of the spore, 8-10 μ in diameter.

Amauroderma infundibuliforme, *Wakef.*

Fungus rigidus, mesopus, circa 17 cm. altus. *Pileus* infundibuliformis, margine involuto, sublaccatus, fusco-pruinosus, sicco fortiter rugulosus, marginem versus leviter zonatus tuberculatusque, 10-14 cm. diametro. *Contextus* albidus vel alutaceus, fibrosus, lineis atris paucis percursus. *Tubuli* lignicolores, contextu obscuriores, 2-3·5 cm. longi. *Pori* minuti, vegeto purpurei, sicco grisei, crasse tunicati. *Stipes* centralis, aequalis, vegeto laccatus, sicco pruinosus, olivaceo-brunneus, 12 cm. longus, 1·5 cm. diametro. *Sporae* subglobosae, laeves vel minutissime punctatae, pallide brunneae, 10 μ diametro.

Tropical Africa. Uganda: Bumpenge Forest; on the ground beneath a dead tree, *T. D. Maitland* 24A (1915).

A very distinct species, marked by the infundibuliform pileus and the hard smooth crust, which when fresh is distinctly laccate, but when dry becomes dull and greyish or olive-brown. Most of the sporophores have grown closely adpressed to the trunk and therefore are not symmetrical.

Hexagonia subvelutina, *Wakef.*

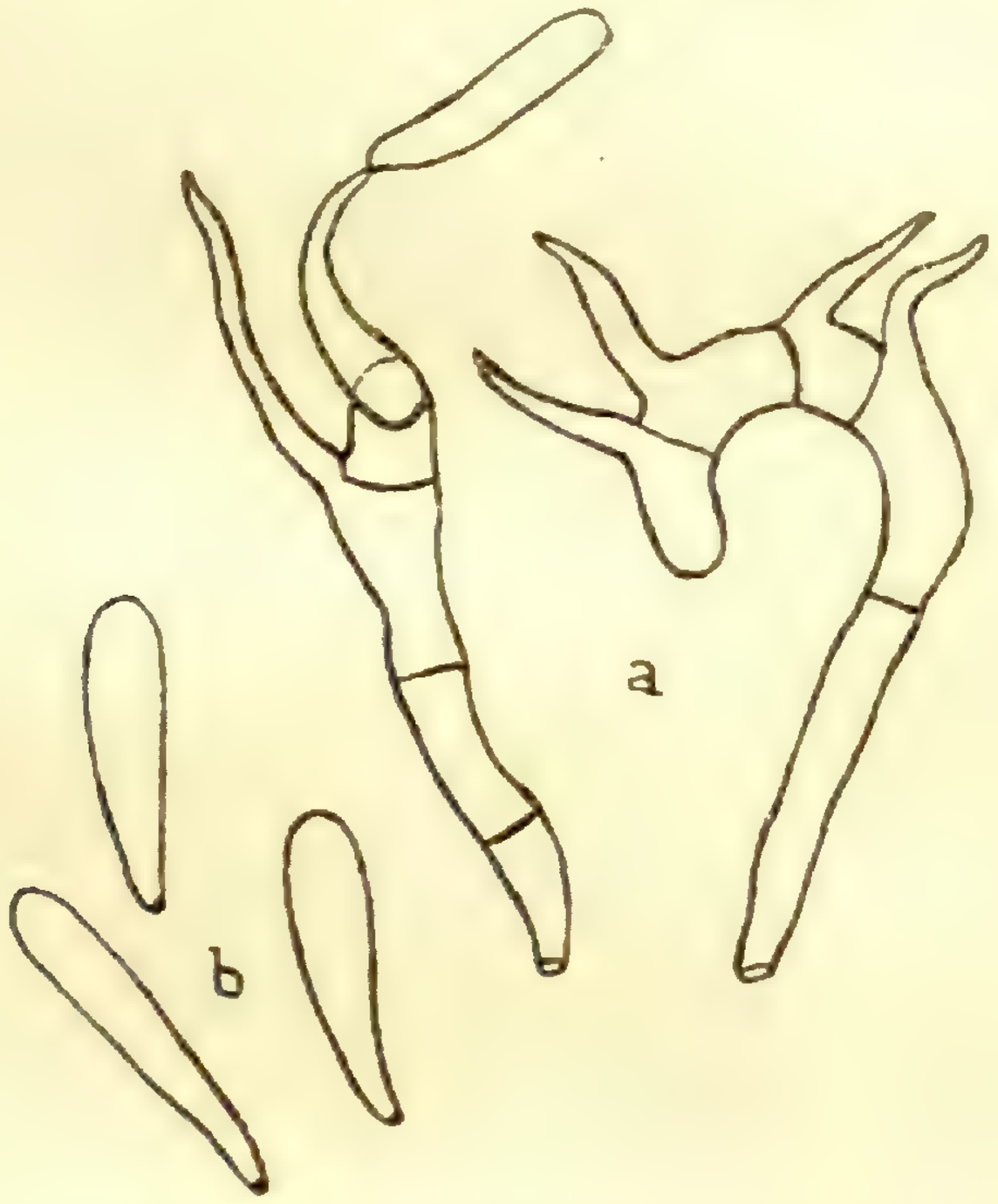
Pileus dimidiatus vel pseudo-stipitatus, lobatus, rigidus, concentrice zonatus, radiatim adpresse strigosus, postice leviter tomentosus, lignicolor, 5-10 cm. diametro, ad 1-1·5 cm. crassus. *Tubuli* ad 3 mm. longi, intus glaucescentes. *Pori* angulati, 2-3 mm. diametro. *Sporae* non visae.

Tropical Africa. East Africa Protectorate; on wood, *W. J. Dowson* 530 (1916).

The specific name is chosen to indicate its close relationship to *H. velutina*. It is distiguished from that species by the much larger pores, thicker substance, and strigose pileus. From *H. rigida*, Berk. it differs in the velvety covering towards the base of the pileus.

Helicobasidium longisporum, *Wakef.*

Sporophorum effusum, pulverulentum, purpureum. *Basidia* uncinata, 4-6-septata, 1-4-sterigmatica, 5-7 μ diametro, demum



a. Basidia. b. Spores. × 850.

purpurea. *Sterigmata* 10-25 × 2-3 μ. *Hyphae basales* purpureae, 5-5·5 μ crassae, septatae, non nodosae, laxe intertextae.

Tropical Africa. Uganda; on roots of *Theobroma Cacao*. *W. Small* 463 (1917).

This is distinguished from all other known species of *Helicobasidium* by the long, coloured spores. The colour of the hymenium is between "livid purple" and "naphthalene violet" of Ridgway's colour standards.

The affected roots show internal mycelium, especially along the medullary rays. Mr. Small states that he is inclined to regard the fungus as a parasite.

Tilletia Wilcoxiana, *Griffiths* in Bull. Torr. Bot. Club, xxxi., 1904, p. 88.

A specimen of *Stipa eminens* var. *Andersonii*, Vasey, from Santa Catalina Island, California, preserved in the Kew Herbarium, shows what is undoubtedly the mature state of this fungus, which was described from immature material. The host plant and the external characters of the smut agree with the description of *T. Wilcoxiana*. As to the spores, however, the following amended description is necessary:—

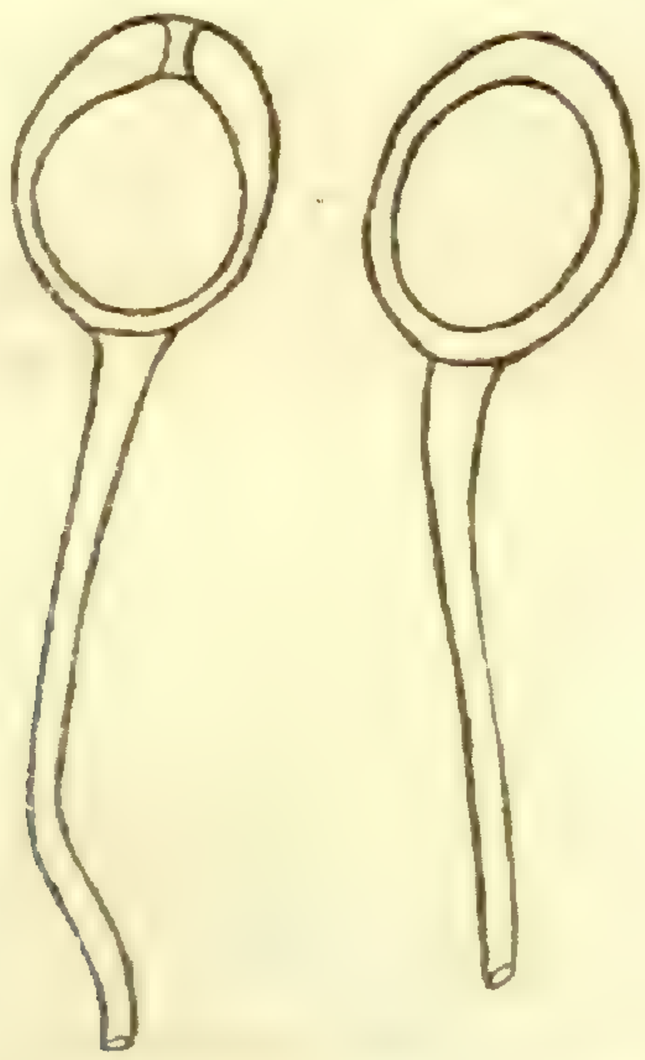
Spores cinnamon in the mass, pale yellow to clear pale cinnamon by transmitted light, very thick-walled. The spore-wall consists of three layers. The outer wall is very thin, hyaline, and apparently of a slightly mucilaginous nature, as it swells slightly and therefore becomes more visible by the action of potassium hydrate. The inner wall is also very thin. Between

Mature spores. × 850.

them is a thick middle wall, brownish in colour, and sculptured in a reticulate manner. The main ribs of the reticulum are arranged more or less spirally, and are connected by much smaller and less distinct cross ribs. In optical section the thickenings give the effect of coarse warts at the circumference of the spore. The mature spores are 18-20 μ diameter, the total thickness of the wall being about 2-2·5 μ.

Uromyces Secamones, *Wakef.*

Sori teleutosporiferi hypophylli, umbrini, firmi, pulvinati, 0·5-0·75 mm. diametro, interdum confluentes, maculis indistinctis ad 3 mm. diametro circinatim dispositis. *Teleutosporae* brunneae, laeves, subglobosae, ellipsoideae, vel subclavatae, apice



Teleutospores. × 850.

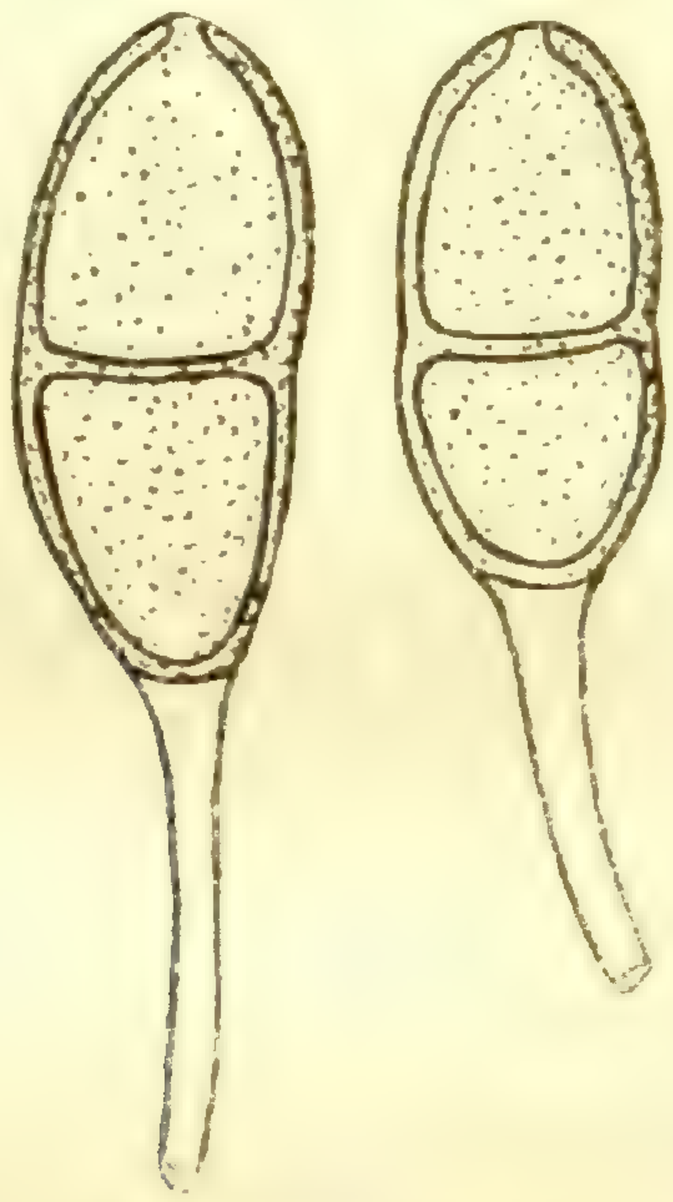
rotundatae, incrassatae, 19-23 × 17-19 μ, rarius majores, verticaliter septatae, 20-22 × 25-30 μ.

Tropical Africa. Uganda; on leaves of *Secamone platystigma*. *R. Dummer* 3012 (Oct., 1916).

This species differs from *U. Howei*, Peck, in the smooth teleutospores. The occasional large, vertically septate spores form a connecting link with the genus *Diorchidium*, but the majority of the spores are typically those of *Uromyces*.

Puccinia Hoheriae, *Wakef.*

Sori teleutosporiferi hypophylli vel caulicoli, sparsi, rotundati vel oblongi, saepe confluentes, epidermide lacerato cincti, castanei, 0·5-1 mm. diametro, maculis parvis atro-purpureis insidentes. *Teleutosporae* ellipticae vel oblongae, medio vix con-



Teleutospores. × 850.

strictae, apice rotundatae non incrassatae, brunneae, episporio minute punctato-granuloso, 35-40 × 15-17 μ; pedicelli hyalini, decid i, 30-80 μ longi.

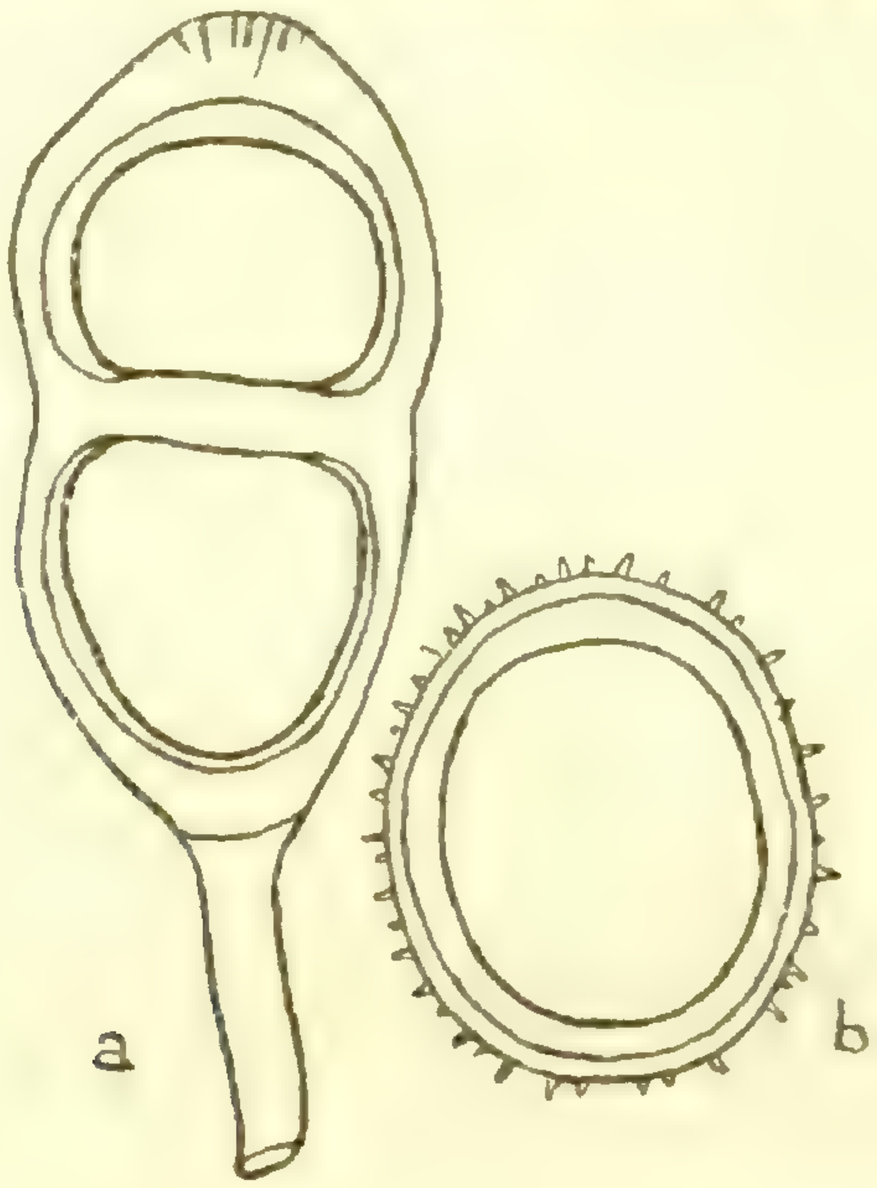
New Zealand. On leaves and stems of *Hoheria populnea* ("Lacebark"),*A. H. Cockayne* (1917).

Near to *P. Plagianthi*, McAlp., but distinguished by the smaller spores, with granular (not reticulate) epispore. From *P. Abutili* it differs in the narrower spores with more finely granular epispore.

Puccinia Berkheyae, *Wakef.*

Sori epi- vel hypophylli, minuti, sparsi in maculis parvis flavidis rotundatis vel irregularibus saepe confluentibus singulatim dispositi. *Sori uredosporiferi* cinnamomeo-brunnei, epidermide diutius tecti, demum epidermide fisso cincti. *Uredosporae* brunneae, globosae vel subglobosae, aculeatae, poris germinationibus tribus instructae, 25-30 μ diametro. *Sori teleutosporiferi* minuti, pulvinati, atro-brunnei. *Teleutosporae* oblongae vel clavatae, medio constrictae, apice valde incrassatae, attenu-

atae, rotundatae, brunneae, episporio minute granuloso, 50-62 × 24-30 μ; pedicelli hyalini, decidui, 50 × 4-5 μ.



a. Teleutospore. b. Uredospore. × 850.

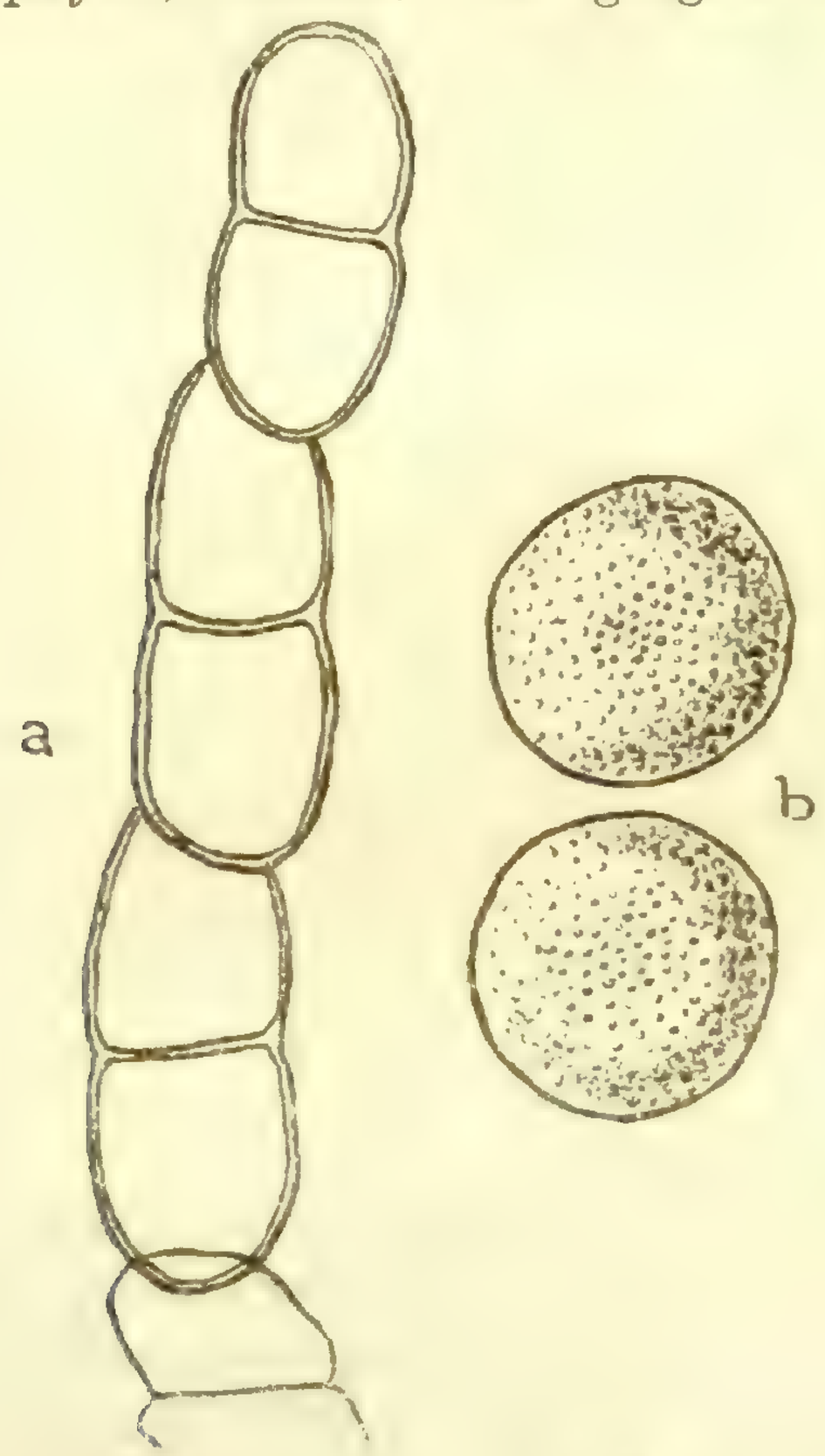
Tropical Africa. Uganda; on leaves of *Berkheya Spekeana*, *R. Dummer* 2752 (Dec., 1915).

Pucciniosira Dissotidis, *Wakef.*

Aecidium Dissotidis, Cooke in Grevillea, x, 1882, p. 124.

Uredo Dissotidis, Cooke, loc. cit.

Maculae distinctae, aridae, pallide brunneae, 1-2 mm. diametro. *Sori* hypophylli, minuti, in greges rotundatos arcte



a. Portion of a chain of Teleutospores. b. Two Aecidiospores. × 850.

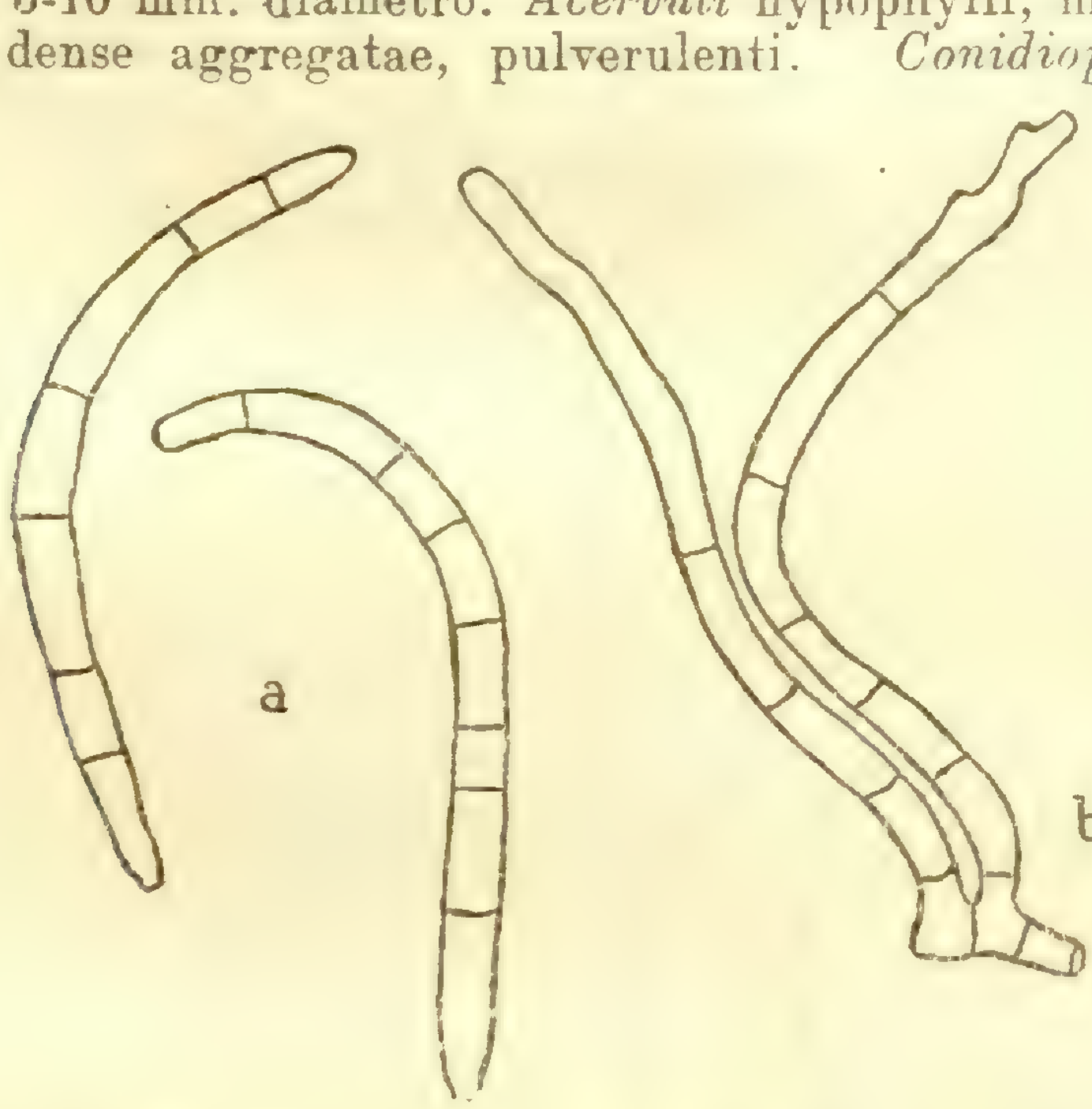
dispositi. *Aecidia* minuta, cupuliformia, pseudoperidio albido margine crenulato cincta. *Aecidiosporae* globosae, hyalinae vel stramineae, tenuiter tunicatae, episporio minute denseque granuloso, 20-23 μ diametro. *Uredosporae* non inventae. *Sori teleutosporiferi* firmi, immersi, minuti, sine pseudoperidio. *Teleutosporae* catenulatae, hyalinae vel stramineae, laeves, ellipticae vel oblongae, medio leviter constrictae, tenuiter tunicatae, 1-septate, cellulis demum secedentibus, 30-35 × 14-17 μ.

Tropical Africa. Uganda; on leaves of *Dissotis incana* and *Dissotis* sp., *R. Dummer* 2157, 2865.

The aecidia described by Cooke as *Aecidium Dissotidis* occur on the same leaves with teleutosori, and on similar spots. There is no doubt that the two forms are connected. In the type material of "*Uredo Dissotidis*," however, only teleutospores and an occasional aecidiospore can now be found, hence Cooke's description cannot be confirmed. This is the only species of *Pucciniosira* for which an Aecidium stage has been described.

Cercospora cannabina, *Wakef.*

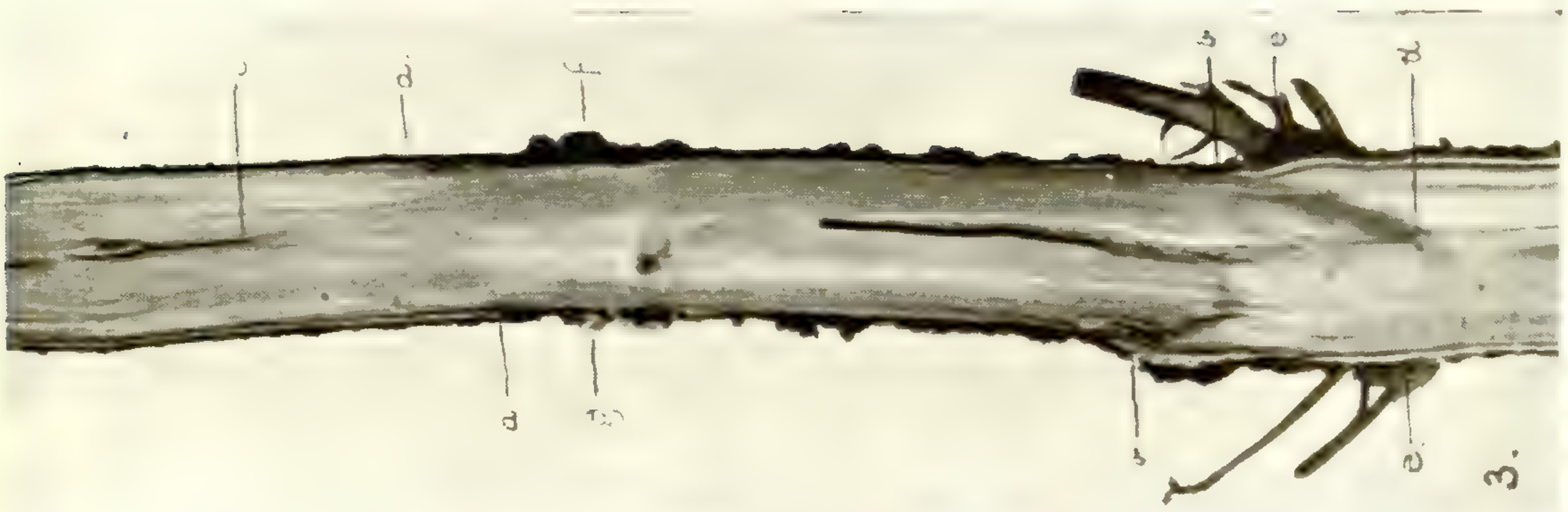
Maculae rotundatae vel oblongae, interdum confluentes, pallescentes, 3-10 mm. diametro. *Acervuli* hypophylli, minutissimi, olivacei, dense aggregatae, pulverulenti. *Conidiophora* simplicia, vix fasciculata, septata, olivaceo-fuscidula, 70-85 × 4 μ. *Conidia* curvula, apice rotundata, dilute olivacea, ad 10-septata, 40-90 × 4 μ.



a. Two Conidia. b. Conidiophores. × 850.

Tropical Africa. Uganda; on leaves of *Cannabis sativa*, *R. Dummer* 1320 (Dec. 1914).

The conidiophores are erumpent in very small tufts of usually only 4 to 6. Owing to the crowded habit, however, and the long conidiophores and spores, the under-surface of the leaf shows more or less continuous patches of olive tomentum. In this respect the species resembles *Cercospora Odontoglossi*, Prill et Del.



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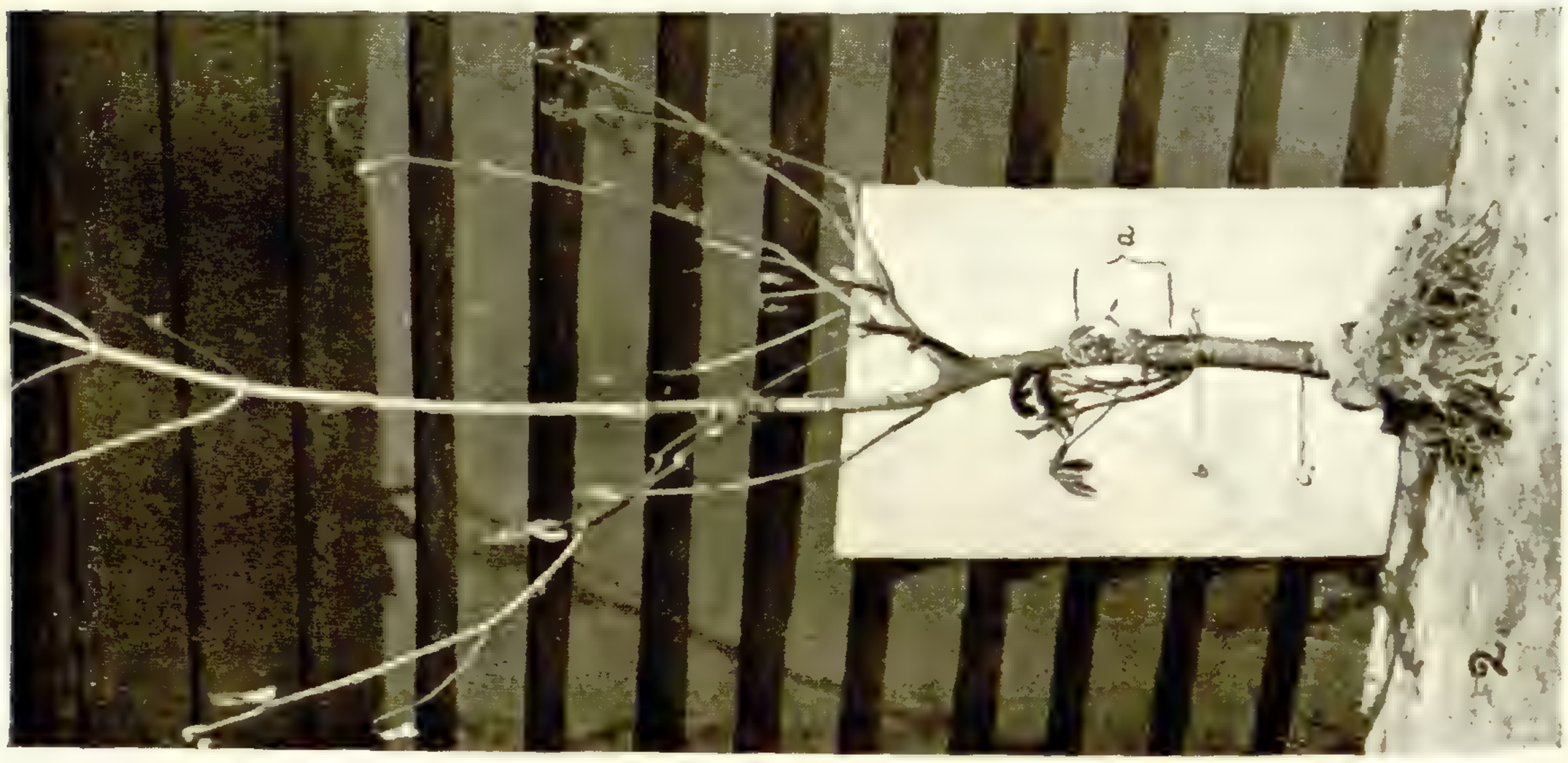

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XXXIV.—ON A TREE OF AESCULUS PAVIA KILLED BY BOTRYTIS CINEREA.

STUDIES FROM THE PATHOLOGICAL LABORATORY: V.

William B. Brierley.

(With Plate.)

On May 28th a young specimen of *Aesculus Pavia* growing in the Royal Botanic Gardens, Kew, was observed to be in an unhealthy condition. The leaves were thoroughly wilted and the tree was apparently suffering from the effects of extreme drought. Several specimens of *Aesculus* sp. were standing in the immediate vicinity and as these seemed to be perfectly healthy with turgid extended leaves, a closer examination of the original tree was made. Around the base of the main stem was a circle of bare earth about one metre in diameter, and this soil shewed no appreciable difference in humidity or general appearance from that surrounding the neighbouring trees. About twenty centimetres above the soil surface a circle of new shoots, averaging three to five centimetres in length, sprouted vigorously from the stem. Commencing immediately above these shoots a zone of about ten or twelve centimetres of the bark was slightly shrunken, and sodden or discoloured in appearance; and bore a few immature pustules of *Botrytis* conidiophores. The leaves of the tree were green but hanging in a wilted and limp condition.

Two days later the leaves were no longer flaccid but dry and brittle, and the entire upper portion of the tree was in a desiccated state. The basal shoots were of a dark maroon-purple colour* and growing with extraordinary rapidity and vigour. the longer ones being twenty-three to twenty-six centimetres in length (Pl. vii. Figs. 1 and 2). The diseased region immediately above these showed an abundance of the pale-smoke-grey pustules of *Botrytis*, which obviously coincided with the position of the lenticels in the bark (Pl. vii. Fig. 1, a). Above this region the lenticels were inconspicuous and small, whilst below they were large and tumescent (Pl. vii. Fig. 1, b, c). The diseased tree was about four and a half metres in height and of a moderately strong and vigorous growth. Its age was six years, and the affected region of the stem had a diameter of 4·5 cms. On May 31st the specimen was taken from the ground and photographed (Pl. vii. Figs. 1 and 2).

The diagnosis appeared perfectly straightforward and simple, and the death of the tree was attributed to an invasion of the main stem by *Botrytis*, which, plugging the conducting elements, effectively cut off the water supply to the upper portion of the tree, giving rise to the symptoms of extreme drought. This barrier would cause an excess of food material to accumulate immediately below the diseased region and in consequence the latent or adventitious buds situated here would be stimulated into active development, and a circle of new and vigorous shoots

* All the colour terms used are in accordance with Ridgway, R., "Color Standards and Color Nomenclature," Washington, 1912.

would arise. The deficiency of water in the upper portion of the stem would cause the lenticels to shrivel and become inconspicuous, whilst the excess of water below the diseased region would cause them to become tumescent.

The rapid killing of a large woody tree by the cutting off of food supplies owing to an invasion of the main stem some considerable distance above the soil surface is a sufficiently unusual mode of behaviour for *Botrytis* to make a further examination appear of some interest.

Period of Attack.—One of the striking features in this case is the extreme rapidity with which the upper portion of the tree was killed; and this is made more noteworthy when account is taken of the fact that the wood of *Aesculus Pavia* consists largely of fibres and tracheids, and that although the vessels are comparatively numerous they are of small diameter, and there is little wood-parenchyma tissue. In addition the medullary rays are usually one and rarely more than two cells in width, so that the wood is moderately compact and dense. The development of mycelium even in open woody tissues is usually very slow, and trees attacked by virulent and destructive fungus-parasites not infrequently remain alive for many years, only eventually succumbing to the cumulative effects of the invasion. Similarly in pure cultures of parasitic fungi on wood blocks, the penetrative power of the mycelium in a radial direction is slight, and after a period of several months the hyphae are not usually found at a greater depth than two or three centimetres. In the pure cultures of *Botrytis* upon sterilised blocks of willow and horse chestnut made by Brooks and Bartlett* "the hyphae were seen to have penetrated but a short distance and were only found in those vessels and cells of the medullary rays which were near the surface of the blocks of wood". The slight penetrative power of *Botrytis* in lignified tissues has recently been demonstrated from another point of view by Brown,† for he has shown that the active extract of this fungus, which, when injected into floral structures "produces rotting and death within half an hour" is totally without action on tissues of a hard woody nature. Again woody plants can, as a rule, withstand the cutting through of the greater part of their sap-wood by either artificial or mechanical means, or canker inducing and other fungi, without serious detriment to the immediate condition of their health. In consequence of the above factors the rapid wilting of a tree is only rarely due to fungal attack, and most usually must be attributed to fumes in the soil, extreme drought, or some other factor which affects in a general manner the whole root system. Where it appears that the wilting must be due to fungal invasion, these symptoms imply a remarkable rapidity of mycelial development, and a most unusual thoroughness and completeness of tissue permeation. If the fungus be *Botrytis* as in the present case this would seem even more noteworthy.

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* Brooks, F. T., and Bartlett, A. W.: Two Diseases of Gooseberry Bushes, Ann. Mycol, vol. viii. No. 2, 1910.

† Brown, W.: "The Action of Botrytis cinerea," Ann. Bot., vol. xxix, 1915.

When the tree was first observed on May 28th. the leaves had completed their full expansion after the long winter, and were of normal size and growth, indicating that their development had not been interfered with in any way. They were thoroughly wilted, however, and hung in a limp and flaccid condition. Two days later the upper portion of the tree beginning from the *Botrytis* zone was in a desiccated state, and the leaves were brittle and easily detachable. These symptoms are significant of a very recent cause of drought due to a factor operating in so active and rapid a manner as to form almost immediately a complete barrier to all water conduction in the stem. If the *Botrytis* mycelium in the diseased region is this factor, as appears to be the only probable hypothesis, its behaviour is remarkable.

As the tree was only discovered during the late stages of the fungal invasion the exact length of time from the primary attack to the death of the host is unknown. A study of the weather conditions during the month of May is, however, instructive. From the 1st of May until May 16th no rain fell at Kew, and the weather was consistently bright and sunny. The temperature was comparatively high, the maximum during this period averaging 20·2° C. and the minimum 6·7° C. From May 16th until May 23rd the weather was dull and showery, 4·19 cms. of rain falling in seven days. The average maximum temperature fell by three degrees, whilst the average minimum increased by three. From May 24th until the end of the month there was a recurrence of the earlier weather conditions with a slightly increased temperature but occasional dull days. Rain only fell on the 29th May when 1 cm. was recorded.

It is well known that the active development of *Botrytis* is peculiarly dependent upon the presence of warm, humid, and equable conditions, and this is especially true of the infection stages. The brief wilting period indicating the unusual rapidity with which the fungus must have developed in the tissues has already been noted. When these factors are borne in mind, and the various phenomena presented by the host tree are correlated with the weather conditions, it appears extremely probable that the primary fungal attack must have occurred during the dull wet week of equable temperature extending from May 16th to May 23rd. This would give a maximum period of fifteen days from the initial penetration of the mycelium or germinating spore to a state of host permeation resulting in the complete desiccation of the tree.

General Distribution of the Fungus in the Host.—In order to determine the degree of penetration of the host tissues by the fungus, the main stem of the tree was carefully divided in a radial longitudinal plane. The diseased area was then visible by reason of its discoloration, and this was greatly accentuated by a few hours' immersion in water (Pl. vii. Fig. 3).

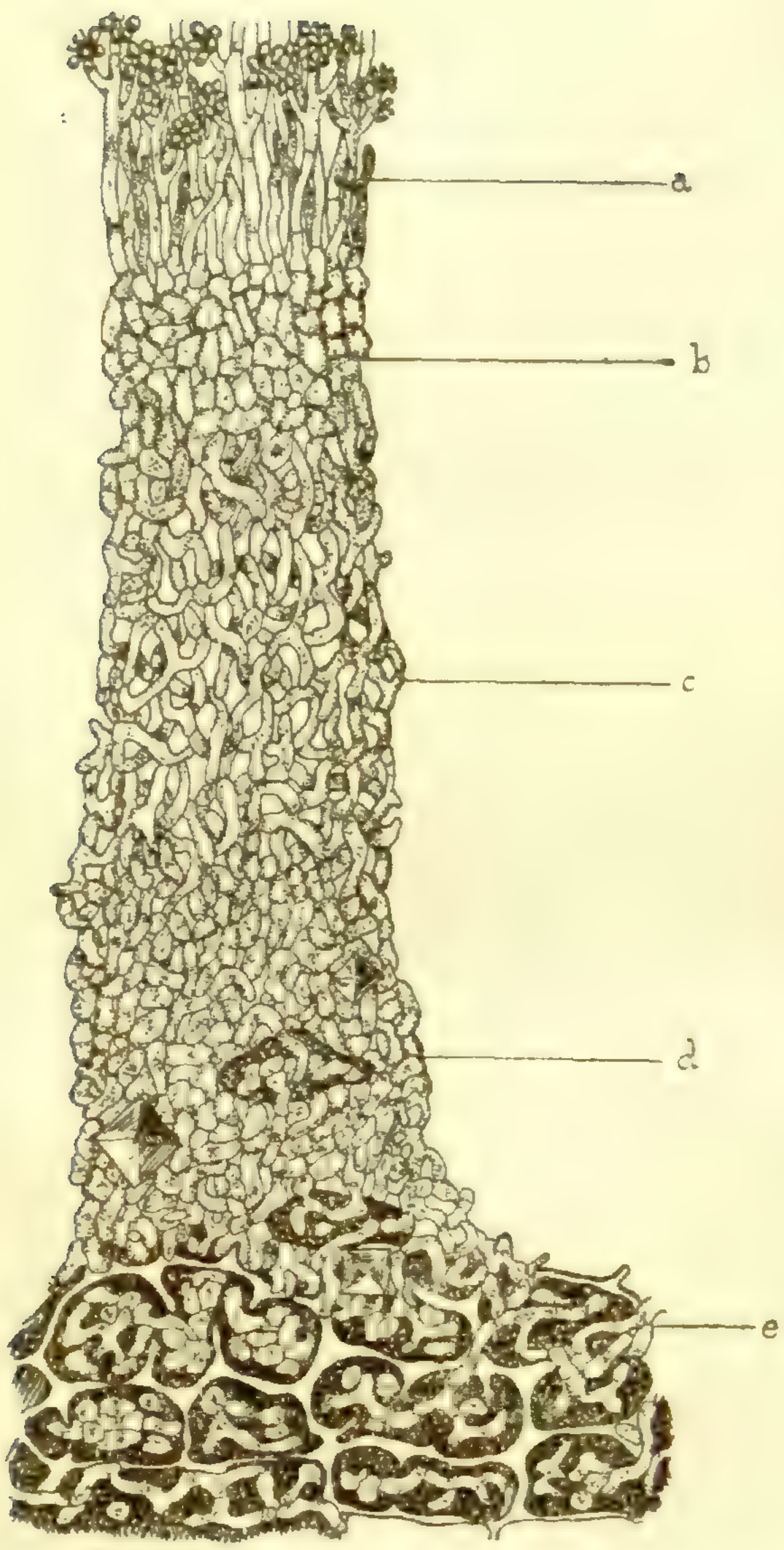
In section the diameter of the affected portion of the stem was appreciably less than that of the non-affected regions, but the most striking distinction lay in the general appearance and

colour of the diseased area. The upper portion of the stem was of a cartridge-buff colour, perfectly dry in appearance, and with a tendency for the tissue elements to tear up. Separating this from the diseased wood and marking the upper extent of mycelial development was a very diffuse olive-buff zone (Pl. vii. Fig. 3, a c a). This merged into the pale-olive-buff of the diseased tissues, which were dull and waterlogged in appearance. The lower limit of fungal growth was sharply defined by a narrow chamois coloured zone extending downward across the wood (Pl. vii. Fig. 3, b d b). The lower healthy portion of the stem contrasted sharply with the tissues above, being bright and richly sappy in appearance and of a marguerite-yellow colour. The diseased region of the cortex was even more sharply defined than the affected wood, for protruding through the collapsed sepia coloured cells were the pustules of *Botrytis* conidiophores. The dry deep-olive-buff coloured cortex above was sharply divided from the dead tissues (Pl. vii. Fig. 3, a) whilst the moist sappy cortex below was of a pale-glass-green colour and bordered abruptly on the diseased cortex (Pl. vii. Fig. 3, b). In addition the latter adhered closely to the wood, whilst the dry cortex above and more especially the healthy cortex below tended to split away from the wood in the plane of the cambium. The demarcation of the affected region has been described in some detail partly because of its distinctiveness, and partly because it shewed in a striking manner that the mycelium of the fungus advanced more rapidly in the woody cylinder of the host than in the cortical tissues (Pl. vii. Fig. 3, a-c, b-d), a result at variance with the experience of previous investigators.

There was no differential discoloration of the wood in transverse section as was found by Brooks and Bartlett in gooseberry bushes attacked by *Botrytis*.

Distribution of the Fungus in the Cortex.—The cortex, bast, and cambium are penetrated in all directions by the mycelium, and a careful examination of the tissues between the healthy and diseased regions, showed that the cells are killed in advance of the actual fungal invasion. In the affected zone the cells lose their content and the cellulose walls become swollen, yellowish in colour and highly refractive. The discoloration and death of the cells occurs before there is any visible effect on the cell-wall. The cell-wall substance is not infrequently finally disintegrated, the middle lamella being the last to disappear, and in the tissues, lacunae are formed which become filled with loosely formed pseudo-parenchymatous masses of mycelium. The relation of the mycelium to the cells of the host, and the nature of the parasitism of the fungus will be discussed in greater detail in a further communication. (Text Fig. 1, e.) It is interesting to compare this with the results obtained by Brown* working with *Botrytis* extract. "It was shewn that the first demonstrable action consisted in the solution of the middle lamella uniting contiguous cells, with the result that coherence of the tissue was destroyed. The attack

* Brown, W. On the Physiology of Parasitism, New Phyt. vol. xvi. 1917.



Text fig. 1.

was, however, not confined to this, and the general body of the cell disintegrated, though complete solution of all constituents did not take place. At a comparatively late stage in the process the cells lost their power of becoming plasmolysed in hypertonic solutions. Thus of the two manifestations of the action of the extract, the toxic is subsequent to the enzymic". Blackman and Welsford,* however, found that in the infection of the mesophyll of bean leaves by *Botrytis* "the first morbid change is seen as a slight disorganisation of the protoplast; the swelling of the wall is not noticeable till a later stage". The present results agree very well with those of Smith,† who states that "two different effects must be clearly distinguished, one following the other: first the death of the cells; and second the disintegration of their walls and contents."

In the present case the hyphae were most usually found ramifying abundantly in a loose weft through the disorganised cortical cells, showing no discrimination for an intercellular as distinct from an intracellular course. Under each lenticel in the bark the hyphae mass together forming a pseudo-sclerotial structure which protrudes through the lenticel and resolves itself into a dense cluster of conidiophores (Text Fig. 1 & Pl. vii. Fig. 1, a, Fig. 3, f, g). These stromatic masses usually occupy about two-thirds of the depth of the cortex, are variable in size, and are plainly visible to the unaided vision. They are not sharply defined but are formed by the merging of the cortical-hyphae into a complex of disordered cortical cells and crystals embedded in a mycelial weft. (Text Figs. 1 and 2, e, d.) The centre of this structure is purely hyphal but never forms the solid dense tissue of a true sclerotium (Text Figs. 1 and 2 c). Passing through the lenticel to the outside of the stem this stroma gives rise directly to *Botrytis* conidiophores (Text Figs. 1 and 2, b, a).

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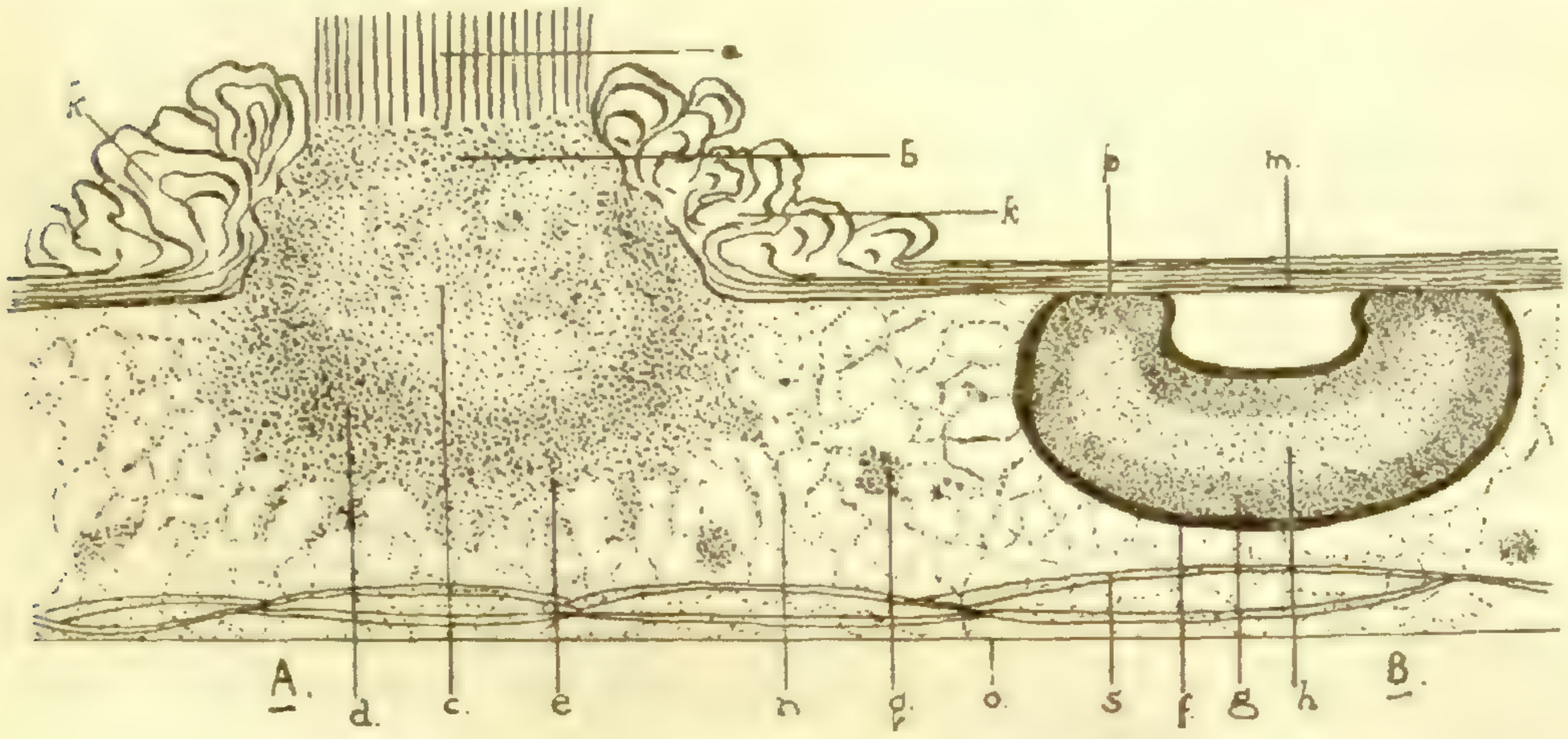
* Blackman, V. H. and Welsford, E. J. Infection by Botrytis cinerea, Ann. Bot. vol. xxx. 1916.

† Smith, R. E. The Parasitism of Botrytis cinerea, Bot. Gaz. xxxiii. 1902.

These, and to a certain extent the basal tissues are partially extruded pushing back in all directions the corky tissues of the lenticel. (Text Fig. 2, A, a, b, k.) The conidiophorous-stromata or pseudo-sclerotia are only found in relation to the lenticels and as far as could be determined every lenticel in the diseased region was occupied in this manner (Pl. vii. Fig. 1, a), this probably being the cause of the sodden, water-logged appearance of the affected tissues. Somewhat similar structures have been described on the vine by Istvánffi* and on lime trees by Smith.† In the former case the stromata were considerably more definite in structure, and were very small, being formed under the



Text fig. 2.

cuticle; whilst in the latter, they commenced as true sclerotia, but as they passed to the exterior of the host became diffuse, and finally resolved into conidiophores. In neither case is any relation to the lenticels mentioned, nor do the figures indicate that this is present.

In addition to these structures in *Aesculus Pavia* true sclerotia are formed in equal abundance. These average from 1·5 mm. to 2 mm. in diameter, and from 0·5 to 1 mm. in thickness (Text Fig. 2, B). They are circular or irregularly oval in outline and possess one convex and one concave side, the latter being closely adpressed to the bark of the host. (Text Fig. 2, B.) The central portion consists of a mass of elongate ramifying hyphae which toward the periphery form a dense and solid tissue enclosed in a brownish-black skin one or two cells in thickness. This skin is absent from the sclerotial ring in contact with the bark (Text Fig. 2, B, p), and this is paralleled by tube cultures of *Botrytis*. Here the sclerotia are strongly concave and most usually adhere to the glass, the narrow, irregular, contact surface of the fungus body being free from the black skin enclosing all other surfaces of the sclerotium. The sclerotia are perfectly discrete bodies with little mycelial attachment at any stage

* Istvánffi, Gy. de: Etudes microbiologiques et mycologiques sur le rot gris de la vigne—Botrytis cinerea ou Sclerotinia Fuckeliana, Annales de l'Institut Central Ampélologique Royal Hongroise, tome iii, 1905.

† Smith, R. E. Botrytis and Sclerotinia: their relation to certain plant diseases and to each other, Bot. Gaz. xxix. 1900.

of their development, and are of a firm cheese-like consistency. Their distribution in the cortex contrasts markedly with that of the pseudo-sclerotia for they are never found correlated with lenticels, but are always adpressed to the unbroken bark (Text Fig. 2, A, B). The sclerotia and conidiophorous-stromata are not successive stages in the development of single bodies; but are discrete entities without intermediate structures, and may be formed simultaneously, for examples of each in various stages of growth are to be found side by side. Whatever the factors may be which determine whether the cortical hyphae at a given spot form a sclerotium, or a stromatic pustule resolving into conidiophores, they evidently bear a direct relation to the lenticels. It is improbable that this stimulus is one of aeration for it is difficult to conceive that this could have so local and so constant an application throughout the diseased cortex. A more probable hypothesis is that the stimulus is one of pressure or contact, and this would derive support from the fact that in tube cultures of *Botrytis*, the conidiophores are formed over the free surface of the medium, whilst the sclerotia are most usually formed in contact with the glass at the periphery.

Distribution of Fungus in the Wood.—The symptoms of extreme drought presented by the specimen had aroused the expectation that the water conducting tissues in the stem would be completely plugged by hyphae. So far from this being the case, however, transverse sections through any portion of the diseased wood showed practically an absence of fungus. The explanation of this was given by radial longitudinal sections for in these it was seen that the mycelium was almost totally confined to the *living* tissues of the central cylinder. From the cortex the fungus passed into the medullary rays which it traversed in a radial direction, and in which it was so abundant as to form the most prominent feature in stained sections, often completely filling the cells of this tissue with masses of fungal hyphae. The mycelium also invaded freely the cells of the wood-parenchyma, but only very rarely could a filament be discovered in any of the water-conducting elements of the stem or in the dead mechanical fibres. The fungus was absent from the pith although ray cells bordering on this tissue contained the fungus in quantity. Sections were taken from all portions of the affected zone, and the constancy and exactitude of this differential distribution confirmed.

Cause of Death of Host.—The absence of the mycelium from the vessels and tracheids immediately proved the original diagnosis to be erroneous, for this was based on the assumption that the water-conducting elements of the stem were choked by masses of hyphae, as in the *Verticillium* disease of potatoes,* or the Wilt disease of cotton.† The extraordinary vigour and turgidity of

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* Pethybridge, G. H. The Verticillium Disease of the Potato, Sci. Proc. Roy. Dub. Soc., vol. xv. 1916.

† Smith, E. F. Wilt Disease of Cotton, etc., Div. Veg. Phys. and Path. U.S. Dept. Agr. Bull. 17. 1889.

the new shoots, and the tumescence of the lenticels below the diseased zone, indicated that here there was no lack of water, and that root pressure was operating in a perfectly normal way. On the other hand the rapid wilting and finally the complete desiccation of the tree commencing from immediately above the diseased zone, showed equally conclusively that the passage of this water up the stem was totally inhibited by some factor in the affected region. Yet in this zone itself the water-conducting elements were free from the presence of the fungus, whilst on the other hand the medullary rays and wood-parenchyma tissues were killed and occluded by the hyphae.

These results seemed to lend strong support to the view that the living parenchymatous cells of the wood and medullary rays are fundamentally important and integral parts of the tissues concerned in the raising of water in the plant, a theory early formulated by Westermaier* and Godlewski,† and more recently upheld by Ursprung‡ and in a slightly modified form by Ewart.§

It is well known that if a localised region of a branch still attached to a tree be killed by artificial means, the leaves above this region eventually wilt and shrivel, the rapidity of the fading being roughly proportionate to the length of the affected portion of the branch.¶ According to the above hypothesis the symptoms of drought shown in this case are directly due to the suppression of the vital activity of the cells of the medullary rays and wood parenchyma, which so reduces the supply of water to the foliage above that the leaves quickly fade. Such a condition appears to be exactly paralleled in the present specimen of *Aesculus Pavia*, the artificial lethal agency being replaced by the action of the *Botrytis* mycelium. The general application and truth of this explanation has, however, been subjected to very severe criticism. Strasburger‖ for example in 1891 demonstrated that stems more than ten and a half metres long continued to conduct water after they had been completely killed by steam, and similar experiments have been repeated by many observers since, which seem to prove indubitably that even when the vital activity of the cells of the wood has been eliminated, water under the action of purely physical forces rises in the stems of high trees. It is evident therefore that the inhibition, by death, of the vital functions of the living cells of the central cylinder in a zone ten or twelve centimetres in extent at the base of the specimen of *Aesculus Pavia*, could not be the primary cause of the wilting of the foliage and the desiccation of the tissues.

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* Westermaier, W. Zur Kenntniss der osmotischen Leistungen des lebenden Parenchym's Ber. der deut. bot. Gesell., Bd. i, 1883.

† Godlewski, E. Zur Theorie der Wasserbewegung in den Pflanzen, Pringsheim's Jahrb. f. Wiss. Bot. Bd. xv, 1884.

‡ Ursprung, A. Zur Frage nach der Beteiligung lebender Zellen am Saftsteigen, Beihefte z. Bot. Centralb. Bd. 28, 1912.

§ Ewart, A. J. The Ascent of Water in Trees, Phil. Trans. Roy. Soc. Lond. vol. 108B, 1905; and vol. 199B, 1908.

¶ See Janse, J. M. Der Aufsteigende Strom in der Pflanze, Jahrb. f. Wiss. Bot., i, Bd. 45, 1908; ii, Bd. 52, 1913, and Ursprung, A., loc. cit.

‖ Strasburger, E. Ueber den Bau und Verrichtungen der Leitungsbahnen in den Pflanzen, Jena, 1891.

Furthermore it has been abundantly demonstrated by Weber,* Janse,† Vesque,‡ and more recently by Dixon,§ that the cessation of the transpiration stream in a branch which has been killed in a local region, is not due to the removal of the vital activities of the living cells, but to the clogging of the conducting vessels above the diseased region, by the products of the morbid changes in the dead tissues, which contaminate the ascending water-flow. This brown gum-like clogging material is deposited in the walls and lumina of the conducting elements immediately bordering the killed region. The adjoining living cells are stimulated to the development of tyloses and so ultimately the passage of water up the stem is completely blocked. Dixon has also shown that the "physical and chemical nature of the sap is profoundly altered by steaming the branch through which it passes" and that the consequent accumulation of poisonous substances in the leaves ultimately causes their wilting and death, even if these branches are given a double supply of water. Attention may be drawn to the fact that it is not the particular method adopted to kill the localised region, which produces the changes, but the morbid products emanating from the dead tissues. In the case of branches attached to trees the period elapsing before wilting of the leaves becomes evident, is rarely less than four or five days and is usually considerably longer; but shoots experimentally poisoned by the degenerative products may show wilting of the leaves in as short a period as two and a half days,¶ a time corresponding approximately with the wilting period in the present specimen of *Aesculus Pavia*.

It appeared not improbable therefore that in the latter case the death of the tree might have resulted from the combined effect of the poisoning of the leaves, and the clogging of the tracheae, by morbid products arising from the cells of the medullary rays and wood-parenchyma which had been killed by the *Botrytis*. This hypothesis would reasonably correlate the presence of the diseased zone of the tree with the symptoms of rapid and extreme drought shown by the foliage.

There were at once evident, however, a number of facts which would not coincide with this theory. If, for example, the leaves were poisoned by the accumulation in their tissues of necrotic matter, their transpiratory functions would cease before the tracheae in the stem were clogged by morbid products, and the immediate result of this would be a slight excess of water in the tissues of the upper portion of the tree. It is difficult therefore to conceive how such a process could in any way give rise to the state of extreme desiccation exhibited by the wood and cortical tissue of the diseased *Aesculus Pavia*. Furthermore Dixon has

* Weber, C. A. Ueber den Einfluss höherer Temperaturen zu leiten, Ber. d. Deutsch Bot. Gesell. Bd. 3, 1885.

† Janse, loc. cit.

‡ Vesque, J. Sur le prétendu rôle des tissues vivants du bois dans l'ascension de la sève, Compt. rend. Tome 101, 1885.

§ Dixon, H. H. Transpiration and the Ascent of Sap in Plants, London, 1914.

¶ Dixon, H. H.: loc. cit.

pointed out that "the leaves which fade after their supporting branch has been killed by heat, fade in a different manner from those which wilt owing to a lack of water. In the former case the margin of the leaf first becomes darkened and this darkened region gradually invaded the leaf between the veins. It then dries and shrivels whilst the green parts immediately round the veins remain comparatively fresh. As this change is taking place these veins usually become pink and finally brown. This coloration is particularly noticeable when the leaves are viewed with transmitted light. Shrivelling and withering of the leaf, except at the edges, does not occur until after these changes are complete". "On the other hand, when leaves fade simply from an insufficient water supply, *e.g.*, on a branch severed from a tree, shrivelling comes on while they are still green. Blackening appears only after shrivelling and occurs in irregular patches. The veins do not change colour and the walls of the tracheae do not appear coloured in transverse section. The first colour change is when the cell-contents of the mesophyll and parenchyma of the veins colour brown after death". It may again be emphasised that the manner of localised killing, whether by steam, chemicals, fungus mycelium or other lethal agency is without importance; the distinction is one between a process of poisoning by the products of morbid and degenerative changes, and the effects merely of a shortage of water.

Now it has already been noted that in the present specimen of *Aesculus Pavia* the leaves at first were limp and flaccid but of a normal green colour. When the tree was taken from the ground three days later the foliage was shrivelled, dry and brittle, and during the subsequent week the leaves merely withered in the manner characteristic of drought, and without any of the symptoms of poisoning.

The desiccated condition of the tissues of the stem, and the manner in which the leaves faded, were strong presumptive evidence that poisoning of the foliage due to contamination of the sap-flow by morbid products, had not occurred. This, however, did not negative the probability that the conducting elements in the stem immediately above the diseased region were choked by the degenerative matter emanating from the dead tissues; and that this clogging, supplemented by tylose formation, was the factor inhibiting the flow of the transpiration stream in the tree.

To determine the soundness of this hypothesis, a careful examination, using microchemical methods, was made of the tissues immediately above the diseased zone and these were compared minutely with corresponding tissues from other parts of the stem. No trace could be detected of any deposition of morbid products either in the walls or in the lumina of the tissues in question, and although, as will be noted later, tyloses were not infrequently present they were not more abundant in this region than in any other portion of the tree. Thus although at first it had appeared probable that the death of the *Aesculus Pavia* under consideration was either a direct result of the suppression of the vital activities of the cells of the medullary rays and wood-parenchyma

in the affected region; or an indirect result of their destruction, by reason of the clogging of the tracheae in the contiguous zone immediately above, by the morbid products of their degeneration; no evidence in support of either of these views could finally be discovered.

It was evident therefore that some other factor existed in the diseased zone; a factor which operated so effectively and rapidly that within a period of a few days a barrier was formed completely checking the upward flow of water in the tree. Below the limit of fungal extension (Pl. vii. Fig. 3, b d b), the tissues were exuberantly healthy and turgescent; above the limit of mycelial growth (Pl. vii. Fig. 3, a c a), the tissues were dry and shrivelled from want of water. In the diseased zone all the living tissues of the stem had been killed and occupied by the fungus, whilst the water-conducting channels were free from hyphae. The death of the cortical, ray and wood-parenchyma tissues, was apparently without importance in the conduction of water up the tree; whilst the conducting elements immediately above and below the diseased region were perfectly free from occlusion by morbid products, and did not contain an abnormal number of tyloses.

The only feasible hypothesis remaining seemed to be that although the water conducting tissues of the diseased region of the stem were free from fungus, they must yet be mechanically occluded in some other way. To determine the nature of this occlusion, if present, a thorough visual and microchemical examination of the diseased tissues was carried out, and these were minutely compared with corresponding healthy tissues from below the affected region, and dry tissues from above. The only ascertainable difference was found to be in the relative abundance of tylose formation in the several regions of the stem. In the duramen xylem of all portions of the woody cylinder tyloses were abundant, and in the peripheral actively-conducting tissues of the healthy wood they were not infrequently present. They are thin walled and in almost all cases extend in a single series along the narrow vessels. The tyloses were difficult of accurate observation in the diseased sap wood, for they were collapsed and shrivelled and usually matted closely together. A careful comparative estimation, however, revealed that there were approximately ten times as many tyloses in a given diseased area as in a corresponding area of healthy wood. It was evident therefore that one immediate effect of the fungal invasion had been to stimulate the wood-parenchyma cells to the active formation of tyloses.

Marshall Ward* demonstrated that in the invasion of tissues by *Botrytis* the host cells are killed in advance of the hyphae by an enzymic body secreted by the young fungus cells. Brown† has recently investigated this active principle and has shown that it is possibly a protoplasmic toxin of an enzymic nature and that it possesses a relatively high coefficient of diffusion. Although it has not yet been proved of *Botrytis* extract it is a

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* Marshall Ward, H. A Lily Disease, Ann. Bot. vol. ii, 1888.

† Brown, loc. cit.

well known property of many toxic bodies, that in dilute solution they act as growth stimulants, and proliferation of plant cells as a result of exposure to various poisonous substances has recently been abundantly demonstrated by Smith.* When the tissues of the present host were invaded the active principle of the fungus would diffuse rapidly through the cells, and at the extreme limit of its diffusion range it would appear probable that the highly dilute toxic body stimulated the living wood-parenchyma cells to the formation of intrusive vesicles. The period of time during which the tyloses must have been formed could only be very brief, for as has been noted the active principle of *Botrytis* diffuses rapidly, and the toxic substance would very shortly be present in a lethal concentration. Immediately this acted upon the cells of the wood-parenchyma, the tyloses would collapse and shrivel together choking the lumina of the tracheae with dead matter; the rapidity of this process being manifested in the brief wilting period of the foliage of the tree. These plugs of dead tyloses were sufficiently abundant for it to be not improbable that they were primarily responsible for the complete interruption of the water stream in the stem of the *Aesculus Pavia* under consideration.

Longitudinal Extension of Fungus in Host.—As the roots of the tree were in a normal state of activity the blocking of the transpiration current would immediately result in an excess of raw food material in the region below the barrier. Here there had formerly been a few branches the cut ends of which were occluded by wound cork (Pl. vii. Figs. 1, d, and 3, e). The excess of food material stimulated the growth of adventitious buds from this callus, resulting in a whorl of vigorously growing shoots (Pl. vii. Figs. 2 and 1). In addition to utilising the food excess from below, these shoots would, within a certain range draw upon the tissues above them, so that these cells would be depleted of food content, and a "starvation zone" would thus be established between the whorl of shoots, and the downward trend of fungal extension. A careful examination of the tissues shewed that mycelial penetration in a longitudinal direction had apparently ceased, the limits being marked by the discoloured zones already described. Downward this cessation was sudden, corresponding with the sharply defined line which extended across and through the tissues, but which in the sap-wood region always lay above the insertion of the shoots (Pl. vii. Fig. 3, b d b). It was found that in the narrow intervening region, the tissues, although beyond the range of diffusion of the active principle of the fungus, were practically devoid of content, and it would appear probable that the limitation of downward mycelial extension was due to the inability of the *Botrytis* to cross this "starvation zone". In an upward direction the cessation of growth was much more gradual, corresponding with the comparatively broad, diffuse, discoloured zone marking the boundary of the diseased region (Pl. vii. Fig. 3, a c a); and the inability of the fungus to develop further was probably due to the increasing desiccation of the wood.

* Smith, E. F. Mechanism of Tumour Growth in Crowngall, Jour. Agr. Res. vol. viii. 1917.

Infection of the Host.—The conidia of *Botrytis* show very great variability in their power of attacking plants, this depending upon the particular strain of the fungus, upon the host, and upon the incidental conditions in the environment at the time of infection. Marshall Ward found the spores capable of infecting lily leaves, whilst Kissling* describing an epidemic of *Botrytis* among gentians found that the conidia could not attack the leaves. Infection occurred through the stigma and anthers, and this agrees with Nordhausen's results† in which non-cuticularised organs succumbed readily to the attacks of germinating conidia, whilst only under certain special conditions of humidity, lack of light or flaccidity could the leaves be infected. Potter‡ found no difficulty in directly infecting turnips and potato haulms with the conidia of *Botrytis*, whilst Brooks§ could only infect lettuce plants after they had been kept for some days in darkness or were yellowing. Brooks and Bartlett‖ were unable to infect gooseberry bushes with conidia even when these were placed in wounds in the cortex. Tubeuf¶ and Behrens** found that the spores germinated in water and immediately infected young developing shoots and needles of various conifers. Massee†† confirmed this, but stated that the spores cannot pierce the bark of a two year old seedling directly, but only as a wound parasite. I have found no difficulty‡‡ in directly infecting wounded surfaces of fig trees with conidia but have totally failed to infect uninjured surfaces. Blackman and Welsford (loc. cit.) found that spores very often failed to infect a bean leaf, and Brown (loc. cit.) from the same laboratory, has demonstrated that the cuticle of leaves offers a very great obstacle to the action of *Botrytis* extract, and further that with tissues of a "woody texture no definite action could be established in any case". As was pointed out by Marshall Ward (loc. cit.) conidia may in almost all cases be rendered capable of penetrating a cuticularised surface of a leaf or stem if their germ tubes be previously invigorated by saprophytic nourishment. Even this, however, does not appear to give them the power of infecting uninjured bark surfaces, and so far as I am aware all successful inoculations of woody plants by *Botrytis* have been achieved by

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* Kissling, E. Zur Biologie der Botrytis cinerea, Hedwigia vol. 28, 1889.

† Nordhausen, M. Beiträge zur Biologie parasitärer Pilze, Jahrb. Wiss. Bot. 1899.

‡ Potter, M. C. Rottenness of Turnips and Swedes in Store, Journ. Bd. Agric., vol. iii, 1896.

§ Brooks, F. T. Observations on the Biology of Botrytis cinerea, Ann. Bot., vol. xxii, 1908.

‖ Brooks, F. T., and Bartlett, A. W. Two Diseases of Gooseberry Bushes. Ann. Mycol., vol. viii, 1910.

¶ Tubeuf, V. K. F. Beiträge zur Kenntnis der Baumkrankheiten, Berlin, 1888.

** Behrens, J. Phytopathologische Notizen, Zeit. f. Pflanzenkrank Bd. v, 1895.

†† Massee, G. A Conifer Disease, Journ. Bd. Agric., vol. x, 1903.

‡‡ Brierley, W. B. Note on a Botrytis Disease of Fig Trees, Kew Bull. 1916, p. 225.

placing either spores or mycelium on previously wounded surfaces.

In the "die-back" diseases of woody plants caused by *Botrytis* such as those of fig trees* ribes bushes† or roses‡ the germ tubes almost certainly enter through injured buds, while in the "die-back" of conifers, infection obtains through the tender young shoots and leaves. In the diseased sapling lime trees described by Smith and the seedling larches by Massee the attack commenced at the soil level, presumably being a direct invasion by saprophytic *Botrytis* in the soil, which entered through some injury caused probably in transplanting.

In the present specimen of *Aesculus Pavia* the distribution of the *Botrytis* pustules, the youngest being at the upper and lower growing regions and the mature ones being in the centre (Pl. vii. Fig. 1, a) indicates that the primary infection occurred approximately in the middle of the diseased region, and would therefore take place about twenty-six centimetres above the surface of the soil. This eliminates the possibility that the attack was a direct invasion of the tree by saprophytic mycelium from the soil as in the limes and larches noted above, and postulates a spore infection. The brief consideration of the biology of spore infection, however, has shown the great improbability of the penetration of an unwounded bark surface by a germinating conidium; but although a thorough inspection of the diseased area was made no wound could be detected. Nevertheless it is almost certain that a minute wound must have been present, and it would seem probable therefore that infection of the *Aesculus Pavia* occurred by a *Botrytis* spore, which chanced to be inserted under favourable weather conditions in this very minute wound in the bark of the tree—a combination of circumstances rarely to be repeated.

Identity of Fungus.—The conidiophores arising from the stromata in the cortex of the host were of the type characteristic of *Botrytis cinerea*, Pers., although the spores were somewhat larger than usual, measuring $12\mu - 15\mu$ by $8\mu - 12\mu$. Cultures were made on potato agar of conidia, diseased bark and diseased wood, and in all cases a typical growth of *Botrytis cinerea*, Pers., was obtained. These were compared with cultures of *Botrytis* from the following sources:—(i) a strain growing saprophytically upon dead lilac leaves; (ii) a strain growing saprophytically upon woody mangolia shoots killed by frost; (iii) a strain causing a die-back of young cypress trees; (iv) a strain causing a "die-back" and fruit-rot of fig trees; (v) a strain obtained from the interior of woody galls on a bush of *Ribes alpinum*, Kew. No constant differences could be determined in the several cultures, although on their host plants these fungi vary greatly both in morphology and manner of behaviour. When cultures of *Botrytis* from *Aesculus Pavia* were inoculated into wounded lettuce plants the typical "lettuce drop" developed. Although therefore the

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* Brierley, W. B., loc. cit.
† Brooks, F. T., and Bartlett, A. W., loc. cit.
‡ Smith, R. E., loc. cit.

behaviour of the fungus in the present specimen is unusual, there is no evidence to prove that the fungus is a special physiological strain, or other than the common *Botrytis cinera*, Pers. reacting to the stimulus of the particular environment presented by *Aesculus Pavia*.

Other Instances of Woody Trees Killed by Botrytis.—The fungus *Botrytis* is not infrequently found upon large woody trees growing as a saprophyte, and in such cases is usually confined to young shoots and twigs which have been killed by frost, or other agency. Very rarely indeed does it develop in the woody tissues of the main stem. In a few cases the fungus is known as an active parasite upon trees, and then is usually the cause of a "die-back" of the shoots. In the common "die-back" of conifers due to *Botrytis* it cannot be said that the fungus attacks woody tissues for only the soft and tender green shoots are destroyed, and only very exceptionally does the mycelium extend into the older lignified tissues of the branches. In the "die-back" of fig trees, roses, and ribes bushes, it is again usually the young sappy shoots which are attacked. In these cases, however, the mycelium not infrequently develops into the hard lignified regions of the branches and occasionally even invades the main stem of the plants. The hyphae extend in a downward direction, growing most rapidly in the cortex, and gradually spreading inwards eventually penetrating all the tissues of the plant.

Only three cases have been described in which in nature *Botrytis* has invaded a woody host at the base of the plant. The first was by Smith in 1900 (loc. cit.) the host plants being young saplings, three to five feet high, of *Tilia parviflora* and *Tilia grandiflora*. The attack commenced at the ground level, and the hyphae spread rapidly upwards in the tissues discolouring the bark in advance of the wood. The invasion occurred probably during the winter months and its progress was sufficiently slow to permit of the neighbouring saplings becoming fully leaved whilst the diseased trees remained in bud, the buds, however, being green and apparently sound. The cortical tissues were gradually destroyed, but the bast was practically unaffected, and a few fungus filaments only could be found in the outermost portion of the wood. Bursting through the bark were "a sort of half formed sclerotia having the normal cellular structure at the base, but lacking a definite surface layer, and resolving above into a dense mass of conidiophores". Under artificial conditions ordinary black-skinned sclerotia developed later in the cortex. The second instance is given in a brief account by Massee (loc. cit.) of a number of larch seedlings attacked at the soil level by *Botrytis*. The cortex was thoroughly permeated by the fungus which formed sclerotia embedded in the tissues. Later these burst through the bark and gave rise to conidiophores.

In 1903 Miss Lorrain Smith* described a disease of the gooseberry caused by *Botrytis*. The host was attacked at the ground level and the bark destroyed; the mycelium of the fungus per-

* Smith, A. L. A Disease of the Gooseberry. Journ. Bot. vol. xli, 1903.

meating the inner cortex and bast almost to the first branches and downwards into the roots. Sclerotia were found on the outside of the bark.

These cases present a number of interesting comparisons with the diseased *Aesculus Pavia*. In the former the infection occurred at the soil level presumably by *Botrytis* growing saprophytically in the soil and the mycelium spread slowly upwards destroying the cortex. In the diseased *Aesculus* the infection took place probably by a spore some twenty-six centimetres above the soil level and the mycelium spread rapidly in all directions, penetrating the medullary rays as far as the pith. In the gooseberry, lime trees and the larch seedlings there was no direct effect on the transpiration stream and the eventual death of the upper portion of the hosts was merely part of a general necrosis. In the *Aesculus* the cutting of the water supply to the upper part of the tree was rapid and complete, and although not a direct result of mycelial thrombosis, was due to a choking of the conducting elements by tyloses formed as a direct reaction to fungal stimulation. The diseased lime saplings normally showed only a form of conidiophorous stromata, whilst in the gooseberry and larch seedlings true sclerotia only were present; these, however, in the latter apparently very shortly giving rise to conidiophores. In the specimen of *Aesculus* both types of structure were present normally and bore a very definite and constant relation to the lenticels.

Thus the disease of lime trees, gooseberry bushes and larches have much in common, but apart from their similar etiology show little resemblance to the diseased *Aesculus Pavia* under consideration.

Conclusion.

The points of interest in this specimen to which attention may be drawn are as follow:—

The position on the tree at which infection occurred.

The symptoms of the disease and the rapidity with which the host, a comparatively large woody tree, was killed.

The distribution of the fungus in the tissues and especially its absence from the water-conducting channels.

The induction of the formation of tyloses which created an effective barrier to the transpiration stream.

The development by the fungus of conidiophorous stromata and of true sclerotia, and the constant relation of these to the lenticels.

A number of very interesting features were presented by the morphology of the fungus in the tissues, and these will be described in a further communication.

I am glad to record my indebtedness to Miss M. N. Owen, Temporary Technical Assistant in the Laboratory, for the preparation of many slides upon which much of the information in the present paper is based.

Explanation of Text Figures and Plate.

Text Figure 1.—Semidiagrammatic vertical section through a small conidiophorous stroma, *a*—conidiophores; *b*—slightly more solid cushion of tissue which resolves into conidiophores; *c*—lose mycelial structure free from host elements: *d*—complex of hyphae, crystals and cortical cells; *e*—mycelium ramifying in the cortical tissue.

Text Figure 2.—Diagrammatic representation of cortex with A—conidiophorous stroma; and B—true sclerotium. A: *a*—conidiophores; *b*—conidiophore cushion; *c*—loose hyphal tissue: *d*—complex of fungus and host elements; *e*—cortical hyphae massing together to form the stroma; *k*—lenticular tissue pushed outwards; *n*—hyphae in cortex; *o*—cambium; *s*—bast fibres; *q*—lacuna in cortex filled by pseudoparenchymatous mass of mycelium. B: *f*—sclerotial skin; *g*—dense tissue of sclerotium; *h*—loose internal tissue; *p*—sclerotial ring from which the dark skin is absent; *m*—unbroken surface of bark.

Explanation of Plate vii.

Fig. 1.—*a*—diseased zone showing *Botrytis* pustules. The young pustules are situated at the margin of the zone, and the mature ones in the middle. Their distribution corresponds with that of the lenticels; *b*—healthy stem shewing tumescent lenticels; *c*—dry stem in which the lenticels may only be seen with difficulty; *d*—wound-callus occluding old branches and giving rise to vigorous adventitious shoots.

Fig. 2.—General appearance of tree immediately after removal from ground. *a*—diseased zone; *b*—whorl of developing shoots; *c*—soil level. The upper portion of the tree is in a thoroughly desiccated condition.

Fig. 3.—Radial longitudinal section through diseased zone; *aca*—upper limit of fungal growth; *bdb*—lower limit of fungal growth; *e*—wound callus from which the new shoots spring; *f*—pustule of *Botrytis*; *g*—fungus pustule showing conidiophorous stroma. Note the dryness of the upper region of the section and the cortex splitting away from the wood. The hollow in the centre of the section represents the position of the pith.

XXXV.—THE GENUS COCOS.

In 1886 Dr. O. Beccari published in Malpighia vol. i. p. 343, a preliminary study of the palms included in the genus *Cocos*, Linn.; he has now supplemented this by a revision, published in the L'Agriculture Coloniale, x. p. 435 (Florence, 1916), in which nine distinct genera are recognised and distinguished as in the key reproduced below. *Barbosa*, *Arecastrum*, *Butia* and *Glaziova*, regarded as subgenera in the earlier publication, are now raised to generic rank, but the name *Glaziova*, Mart. (1871), has been replaced by that of *Syagrus*, Mart. (1824), in order to

avoid confusion with a genus of the same name belonging to *Bignoniaceae* and described by Bureau in 1868; *Butia*, however, is retained, although *Butea*, Koenig (*Leguminosae*, 1795), is a valid genus. These subgenera being eliminated, *Cocos* becomes a monotypic genus, with *C. nucifera*, Linn., as its only species.

The following key gives the diagnoses of the genera of this group.

Key to Cocos and allied genera.

I. Flores foeminei ovati vel ovato-conici, sepalis acutis vel cucullatis, petalis apice valvatis.

*Spatha superior extus plus minusve profunde plicato-sulcata.

1. **Albumen ruminatum.**

Nucleus 1-locularis, pariete tenuiter lignosa, apice operculo rostrato clausus. Albumen oleosum in medio late cavum. Frondium petiolus ad margines inermis	**Barbosa,** *Becc.*
Nucleus 1-locularis, pariete crassissima ossea. Albumen siccum in medio anguste cavum. Frondium petiolus ad margines inermis	**Rhyticocos,** *Becc.*
Nucleus vulgo 1-locularis (vel interdum 2-locularis), pariete tenui, fragili. Albumen vix in centro cavum. Frondium petiolus ad margines spinosus.	**Arikury,** *Barb.-Rodr.*

2. **Albumen aequabile. Frondium petiolus ad margines laevis vel fibrosus.**

Nucleus 1-spermus, pariete crassa ossea intus plicato-gibbosa, foraminibus profunde impressis subbasilaribus; loculorum sterilium vestigiis angustis in substantia ossea endocarpii inclusis. Semen irregulare, gibboso-uncinatum; embryone basilari. Ovarium dense papilloso-pilosum. Truncus annulatus ...	**Arecastrum,** *Becc.*
Nucleus 1-spermus, endocarpii cavitate regulari, conspicue 3-vittata, loculorum sterilium vestigiis membranacesis Semen regulare, embryone basilari	**Syagrus,** *Mart.*

**Spatha superior extus aequalis (non plicato-sulcata).
†Floris masculi stamina 6. Frondium petiolus ad margines conspicue spinosus.
Nucleus 3-spermus, vel abortu 1-2-spermus, loculis regularibus, dissepimentis osseis, foraminibus superificialibus (non impressis); mesocarpium pulposo-fibrosum. Semen regulare; albumine intus vix vel anguste cavo; embryone laterali. Ovarium glabrum. Truncus cicatricibus numerosis depressis signatus ... **Butia,** *Becc.*

††Floris masculi stamina 9 vel plurima. Frondium petiolus ad margines inermis.
Floris masculi stamina numerosa; calyx 3-partitus, basi in pedicellum attenuatus. Fructus globoso-ovatus, nucleo 1-spermo; mesocarpio carnoso-fibroso; endocarpio intus 1-vittato, paullo infra medium 3-poroso; loculorum sterilium vestigiis angustis, in substantia ossea endocarpii inclusis; albumine intus cavo; embryone laterali ... **Jubaea,** *H.B. & K.*
Floris masculi stamina 9-16; calycis sepala libera, basi imbricata. Fructus globosus, nucleo 1-spermo; mesocarpio exucco fibroso; endocarpio intus 1-vittato, supra medium 3-poroso; loculorum sterilium vestigiis obsoletis; albumine intus cavo; embryone laterali **Jubaeopsis,** *Becc.*

II. Flores foeminei globosi, magni; sepala et petala concavo-cucullata et arcte convoluto-imbricata. Spatha striata (non plicato-sulcata).
Floris masculi sepala libera, basi imbricata; stamina 6, Fructus magnus 1-locularis, 1-spermus; mesocarpio spisse fibroso-suberoso endocarpio tenuiter osseo, basi 3-poroso, intus linea umbilicali opaca percurso: loculorum sterilium dissepimentis coriaceis contra endocarpii parietem internam propulsis; albumine oleoso amplissime effosso; embryone basilari ... ... **Cocos,** *Linn.*

The following list has been compiled from Dr. Beccari's paper to show the changes in nomenclature proposed for species which have been in cultivation. The second list gives the names of plants which have been cultivated under the name of *Cocos*, but which have not been definitely identified owing to the absence of flowers or fruit or sufficient information.

Plants cultivated under the name of Cocos with the names now accepted.

The figures refer to the pages in Beccari's paper.

C. Arechavaletana. Barb. Rodr. **Arecastrum Romanzoffianum,** var. **australe,** *Becc.*, 459.

C. australis. Hort. = **Butia capitata,** *Becc.*, 507 (usually).

C. australis, Mart. = **Arecastrum Romanzoffianum,** var. **australe,** *Becc.*, 459.

C. Bonetti, Hort.
C. Bonneti, Linden
C. Bonnetti, Hort. } = **Butia Bonneti,** *Becc.*, 504.

C. campestris, Mart. = **Syagrus campestris,** *H. Wendl.*; *Becc.*, 465.

C. capitata, Mart. = **Butia capitata,** *Becc.*, 507.

C. Chirita, Hort. = **Diplothemium maritimum,** *Mart.* (ex H. Wendl); *Becc.*, 612.

C. comosa. Mart. = **Syagrus comosa,** *Mart.*; *Becc.*, 466.

C. coronata, Chabaud. non Mart. = **Butia capitata,** var. **subglobosa,** *Becc.*, 513.

C. coronata, Mart. = **Syagrus coronata,** *Becc.*, 466.

C. coronata, var. *Todari*, Becc. = **Syagrus coronata,** var. **Todari,** *Becc.*, 466.

C. Datil, Gris. et Dr. = **Arecastrum Romanzoffianum,** var. **australe,** *Becc.*, 459.

C. elegantissima, Chabaud = **Butia capitata,** var. **elegantissima,** *Becc.*, 517.

C. elegantissima, Linden = **Syagrus Weddelliana,** *Becc.*, 468. 612.

C. eriospatha, Mart = **Butia eriospatha,** *Becc.*, 496.

C. erythrospatha, Chabaud = **Butia capitata,** var. **erythrospatha,** *Becc.*, 515.

C. flexuosa, Mart. = **Syagrus flexuosa,** *Becc.*, 466.

C. flexuosa, Hort., non Mart. = **Arecastrum Romanzoffianum,** var. **australe,** *Becc.*, 613.

C. insignis, H. Wendl. = **Syagrus insignis,** *Becc.*, 467.

C. Jatta, Hort. = **Copernicia robusta,** *H. Wendl.* (ex H. Wendl.); *Becc.*, 614.

C. lapidea, Hort., non Gaertn. = **Arecastrum Romanzoffianum,** var. **botryophorum,** *Becc.*, 614.

C. lejospatha, Barb. Rodr. = **Butia lejospatha,** *Becc.*, 520.

C. lilaceiflora, Chabaud = **Butia capitata,** var. **lilaceiflora,** *Becc.*, 518.

C. longifolia, Hort. = **Attalea excelsa,** *Mart.* (ex H. Wendl.); *Becc.* 614.

C. mammillaris, Hort. = **Butia Yatay,** *Becc.*, 498.

C. minima, var. *glauca*, Hort. = **Syagrus Weddelliana,** var. **Pynaertii,** *Hort.*; *Becc.*, 615.

C. Normanbyi, W. Hill. = **Normanbya Muelleri,** *Becc.*, 615.

C. nucifera, *Linn.*; *Becc.*, 532.

C. odorata, Barb. Rodr. = **Butia capitata,** var. **odorata,** *Becc.*, 513.

C. pernambucana, Lodd. = **Syagrus botryophora,** *Mart.* ?: *Becc.*, 616.

C. plumosa, Hook. = **Arecastrum Romanzoffianum,** var. **genuinum,** *Becc.*, 447.

C. Procopiana, Glaz. = **Syagrus macrocarpa,** *Barb. Rodr.*: *Becc.*, 467.

C. Romanzoffianum, Cham. = **Arecastrum Romanzoffianum,** var. **genuinum,** *Becc.*, 447.

C. Rossii, Hort. = **Attalea Cohune,** *Mart.* (ex H. Wendl.); *Becc.*, 616.

C. schizophylla, Barb. Rodr., non Mart. = **Butia Bonneti,** *Becc.*, 504.

C. Urucuru, Hort. = **Attalea excelsa,** *Mart.*; *Becc.*, 617.

C. Weddelliana, H. Wendl. = **Syagrus Weddelliana,** *Becc.*, 468.

C. Yatay, Mart. = **Butia Yatay,** *Becc.*, 498.

Imperfectly known species.

C. attaleoides, Hort.
C. Balansae, Naud.
C. Blumenavia, Hort.
C. botryophora, Hort.
C. Butaei, Hort.
C. coronata, Hort., non Mart.
C. fernambucensis, Hort.
C. frigida, Linden
C. Gaertneri, Blumenau
C. gummosa, Hort.
C. Kotchoubeyi, Linden
C. latifolia, Hort.
C. majestica, Hort.
C. maritima, Hort.
C. Maximiliana, Hort.
C. ovata, Lodd.
C. Piassaba, Hort.
C. reflexa, Hort. Berol. (*Syagrus reflexa*, H. Wendl.)
C. regia, Linden, non Liebm.
C. sylvestris, Hort.
C. Tamaca, Linden
C. Wallisii, Linden
C. Yurumaguas, Linden

XXXVI.—THE INTRODUCTION OF THE SPRUCE FIR INTO BRITAIN.

L. A. Boodle.

A fragment of wood was sent to Kew not long ago by Major V. A. Farquharson, as the identification of the wood was desired in connection with a matter of historic interest, the specimen being a portion of a pole thought to belong to the banner of Scotland captured in the battle of Pinkie in 1547.

An examination of the specimen led to the conclusion that the wood is either Spruce or Larch.

These two trees are not native in Great Britain*, but have been grown in the country for a long time. Botanical works were therefore consulted for statements as to the dates of introduction of Larch and Spruce. The information elicited gives no evidence that either of these had been introduced as early as 1547. A note on the subject has been drawn up, for the reason that a misapprehension appears to have arisen in the case of the records relating to the Spruce.

A reference to the Larch being grown in Britain is made by Parkinson (Paradisus Terrestris, 1629, p. 608), and this is apparently the earliest record, as stated by Loudon (Arboretum et fruticetum britannicum, 1838, vol. 4, p. 2358). Parkinson writes as follows:—"The Larch tree where it naturally groweth, riseth up to be as tall as the Pine or Firre tree, but in our land being rare, and noursed up but with a few, and those only lovers of rarities, it groweth both slowly and becometh not high."

Thirty-five years after the date of Parkinson's "Paradisus" the larch still appears to have been rare, but there was at least one good-sized specimen in the country. This is referred to by Evelyn in his "Sylva" (1664, p. 57) as follows:—"That which now grows somewhere about Chelmsford in Essex, arriv'd to a flourishing and ample Tree, does sufficiently reproach our negligence and want of industry." That large trees were still uncommon a hundred and twenty years later is suggested by the fact that in the 1786 edition of the "Sylva" (vol. 1, p. 310) reference to the same reproach is made in slightly different words, and that the reminiscence of a single specimen, presumably the same one, and here described as "a tree of goodly stature, not long since to be seen about Chelmsford," is chosen as an object lesson. Young trees were however abundant, the larch being stated (vol. 1, p. 280) to be "now very common in all the nurseries of the kingdom."

One may conclude with Elwes and Henry (The Trees of Great Britain and Ireland, ii., 1907, p. 353) that the Larch was probably introduced at about the beginning of the seventeenth century.

An earlier date of introduction is claimed for the Spruce by

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* The Spruce (*Picea excelsa*, Link) was formerly indigenous, remains of this species having been found in the Preglacial Cromer Forest-bed at different localities in Norfolk, though unknown in Britain in later deposits. See Clement Reid, The Origin of the British Flora (1899), p. 151.

Loudon (loc. cit., vol. 4, p. 2302). It will be as well to give his statement in full. "Though the Spruce fir is generally allowed not to be a native of Britain, it appears to have been introduced at a very early period, as Turner includes it in his Names of Herbes, published in 1548, and both Gerard and Parkinson not only give very good engravings of it, but speak of its being found in great quantities in different parts of the island. The early British writers on trees, however, appear to have confounded the Scotch pine with the Spruce fir, and it is remarkable that neither of the above-mentioned writers mentions the Scotch pine at all, though it is probably the tree Parkinson means, when he speaks of the 'firre tree' growing wild in Scotland."

The same evidence is relied on by later writers. Elwes and Henry (loc. cit., vi., 1912, p. 1351), for example, write thus of *Picea excelsa*:—"It appears to have been introduced early in the sixteenth century, as Turner includes it in his Names of Herbes published in 1548; and both Gerard and Parkinson state that it was found in different parts of Britain."

Turner's reference to the Spruce (The Names of Herbes, 1548) is in these words:—"Picea is called in greeke as Theodore Gaza turneth, pitys and after Ruellius peuce* and it is called in duch rottē Dan, wherfore it may be called in englishe a red firre tree." It is difficult to understand why this mention of the Spruce should have been brought forward as evidence that the tree was grown in Britain at the date of Turner's publication, especially as the Larch is also included in his list.

The fact, noted by Loudon, that both Gerard and Parkinson give engravings of the Spruce, proves nothing, since these figures are taken from the works of earlier authors. Thus Gerard's illustration on p. 1172 of the Herball (1597) is the same as that given by Tabernaemontanus (Eicones Plantarum, 1590, p. 940), while the figure in the 1636 edition of Gerard's Herball (p. 1354) and in Parkinson's Theatrum Botanicum (1640, p. 1538) is to be found in Lobel's Plantarum seu Stirpium Historia (1576, p. 633).

On referring to Gerard and Parkinson for the statement attributed to these authors by Loudon, that the Spruce was "found in great quantities in different parts of the island," no such information could be found. Gerard's reference to distribution (The Herball, 1597, p. 1172; also 1636 edition, p. 1354) reads:—"The Pitch tree groweth in Greece, Italy, France, Germanie, and all the cold regions even unto Russia," while Parkinson (Theatrum Botanicum, 1640, p. 1539) merely says:—"The first [i.e. *Picea vulgaris*, The ordinary Pitch tree] groweth usually in all countries with the Firre trees, but seldom neere the Sea."

It appears therefore that a record of the Spruce being grown

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* The index of plants at the end of Hort's "Theophrastus' Enquiry into Plants" (1916), does not include the Spruce. Four species of *Pinus* are given as the equivalents of different trees referred to by Theophrastus under πεύκη and πίτυς, no mention of Spruce having been identified under either of these names.

in this country as early even as 1640 has still to be found.* Moreover the absence or rarity of the tree at a later date may be inferred from Evelyn's remark in Sylva (1664, p. 53):—"I am not satisfied why it [*Picea*] might not prosper in some tolerable degree in England, as well as in Germany, Russia the colder tracts and abundantly in France." The same sentence is repeated in the 1670 edition, while in that of 1786 (vol. 1, p. 278) one reads that the Common Spruce Fir Tree "is a native of Norway and Denmark, where it grows spontaneously, and is one of the principal productions of their woods. It also grows plentifully in the Highlands of Scotland, where it adorns those cloud-capped mountains with a constant verdure." This reference to Scotland appears to be an example of the confusion between Spruce and Scotch Pine mentioned by Loudon, and is surprising at so late a date. Parkinson's reference to the fir tree growing wild in Scotland should presumably also be interpreted as applying to the Scotch Pine, as suggested by Loudon. The sentence in question (Theatrum Botanicum, 1640, p. 1539), which comes under the heading of "Abies, the Firre tree," reads:—"This tree groweth in all the Countries of Germany, Polonia, Denmarke and Macedonia, and in divers other Countries also in Italy, Greece, etc., in Scotland also, as I have beene assured, but not in Ireland or England, that I can heare of, saving where they are planted, and whether there was ever any growing naturally in England at any time heretofore is almost out of question."

To summarise the result arrived at with regard to the Spruce:—no confirmation of the current opinion, that this tree had been introduced by the middle of the sixteenth century, has been obtained; and, further, the references to it quoted above suggest that the Spruce may even have been introduced at a later date than the Larch.

To return to the question of the specimen of wood referred to at the beginning of this note, one may conclude that there was no home-grown timber of either larch or Spruce in the year 1547, and that the pole, assuming its supposed history to be correct, must have been made from imported timber.

Early in the seventeenth century, wood, including masts for ships, was among the imports into Scotland from the continent, as shown by a list of Customs and Valuations of Merchandises of the year 1612.† Similar imports of timber were probably being made in the middle of the sixteenth century, and might have come from Antwerp, whither timber for ship-building was at that time brought by sea from Norway, Sweden, Poland and

* "Picea" is included in Gerard's catalogue of plants cultivated in his garden (Catalogus arborum, etc.), published in 1596, but is omitted from the 1599 edition. As this omission may imply the discovery of an incorrect determination, the record is at any rate under suspicion. "Abies, The Firre tree" is given in 1599, and is taken by Jackson (A catalogue of Plants cultivated in the Garden of John Gerard in the years 1596-1599, ed. B. D. Jackson, 1876), to mean *Pinus Abies*, L. (i.e. *Picea excelsa*), but the correctness of this interpretation may be doubted, especially as "Abies" and "Picea" both occur in the 1596 list.

† See Ledger of Andrew Halyburton, 1492–1503, Edinburgh, 1867.

other countries.* As a good deal of this timber, especially that intended for masts, is likely to have been Spruce, there is nothing improbable in supposing that this wood was available, and that the choice of it for the making of a pole might even be expected.

XXXVII.—MISCELLANEOUS NOTES.

The Fruits of Cydonia japonica and C. Maulei.—The crop of these fruits, usually good, is this year exceptionally so, and owing no doubt to the prevailing desire to utilize everything possible for food, a good many samples have been sent to Kew with a request for information as to their edibility, etc. Like all quinces, they are too harsh and acid to be eaten raw. Nor can they be used by themselves for cooking in tarts, but a few slices may be put in apple tarts for flavouring. The only form in which they can be considered palatable is in that of a jelly. Last year, fruits of *Cydonia Maulei* and of five varieties of *C. japonica* were sent from the Kew collection to the Rev. J. Jacob, of Whitewell Rectory, Whitchurch, Salop, for him to experiment with for jelly-making. He reports that they were all treated alike and that after trying each one "without knowing which was which, he and two friends agreed that the *Maulei* jelly was the best. Then came *C. japonica coccinea*; then *C. j. floribunda*; then *C. j. umbilicata*. The other varieties of *Cydonia japonica* were hardly different from wild crab apple jelly." It is interesting to find differences in the quality of these garden varieties which were, of course, raised originally with a view to flower beauty only.

Whilst the present dearth of sugar continues there will be small opportunity of utilizing the fruits of these Japanese quinces. But when happier times arrive it is evident from Mr. Jacob's report that a conserve, excellent and new to many, may be made from fruits that have mostly been allowed to rot on the ground.

W. J. B.

Chatubinskia, *Rehmann.*—During his travels in South Africa in 1875 to 1877 Dr. Rehmann collected a large number of mosses and Hepaticae, which he distributed in sets accompanied by printed labels bearing details as to the habitat and in most cases also the determination. Amongst the mosses were many proposed new species of which descriptions were not published at the time, but this was done in some cases by Dr. Carl Mueller in Hedwigia, xxxviii. pp. 52-155 (1899), while others were merely enumerated in the Revue Bryologique, 1878, pp. 69-71, and in General Paris' Index Muscorum, but up to the present time no general list of this valuable collection has appeared. No. 595, collected in the Transvaal, was regarded by Rehmann as a new genus, for which he proposed the name *Chatubinskia africana*, which up to the time of the recent issue of T. R. Sim's Handbook of the Bryophyta of South Africa

* See Ledger of Andrew Halyburton, 1492–1503, Edinburgh, 1867, Preface, p. xxxvii.

(p. 199) had been neither described nor identified. The specimen at Kew shows that this is not a moss, but the almost cosmopolitan hepatic, **Herberta juniperina,** *Spruce*, in Trans. Bot. Soc. Edinb., xv., p. 342 (1885); *Jungermannia juniperina*, Sw. Fl. Ind. Occ., p. 1855 (1806); *Schisma juniperinum*, Dmrt. Comm. Bot., p. 114 (1822); *Sendtnera juniperina*, Nees in Gott., Lindenb. et Nees, Syn. Hepat., p. 239 (1844).

The locality given on Rehmann's label is: "Transvaalia; in silvis primaevis mont. Lechlaba in latere meridionali in summi montis Snellskop ad arborum truncos." C. H. W.

Candle Nut or Indian Walnut (*Aleurites triloba*, Forst.).—A tree 40 to 60 ft. high; native of Polynesia and Malaya, distributed by cultivation to India, Burma, Ceylon, Hongkong, Mauritius, West Indies, East Africa (specimens of nuts sent to Kew from Blantyre) etc.

Allied species *A. cordata*, R. Br., *A. Fordii*, Hemsl., and *A. trisperma*, Blanco, have been dealt with in previous issues of the Bulletin (see "Chinese Wood Oil," 1906, pp. 117-119, pp. 398-399; "The Wood-oil Trees of China and Japan," 1914, pp. 1-4; and "A Revision of the Synonymy of the Species of Aleurites," 1906, pp. 119-120). As a source of oil the species under consideration is of equal importance, though it has not previously been given a place in the Bulletin, except for synonymy (1906, p. 121) and a short note under Fiji Islands (1887, Sept., p. 7), where it is stated "this plant is widely distributed in tropical countries. The seeds contain a large quantity of oil, which is obtained by expression, and because of its drying properties is used for mixing with paints under the name of Country Walnut Oil. The kernels, when dried and stuck upon a stick, are used as candles in the Polynesian Islands."

The nuts and oil have been reported to be edible; but this is open to serious question, as considerable difference of opinion exists amongst writers on the point. Having regard to the Order (*Euphorbiaceae*), and the close alliance with species known to be distinctly poisonous, it would be advisable not to rely on the oil for table use; it can be readily dispensed with for this purpose since we have so many more oils of proved quality and that come nearer the standard of "olive oil." The nuts might pass locally for food, but only when quite fresh. According to the Tropical Agriculturist (*seq.* p. 300) "the half-ripe fruits with salt have a delicate flavour, but the ripe fruits are unwholesome and only eaten in time of scarcity." This uncertain character is borne out by the variation in analyses of the oil—some comparisons of which are given in Colonial Report, No. 88 (Misc. Series), 1914, pp. 449-450—extracted from nuts forwarded from Hongkong and Mauritius to the Imperial Institute. The oil, however, is of growing importance because of the industrial uses to which it may be put, and the above report bears out the opinion already referred to as to the drying properties, typified by linseed oil, and recommends it "for the manufacture of soft

soap, the preparation of oil varnishes, paints, and linoleum and for other similar purposes to which oils of this class are applied industrially." Further, the value (1906) for nuts in Europe is given at £12 to £13 per ton, and of the oil (1911) at £28 to £30 per ton, with the residual cake at £1 10s. to £2 per ton—suggested for fertilising. The percentage of oil in the kernels has been variously quoted at from 50 to 68 per cent., and where the oil cannot be expressed locally it is recommended that only the kernels be exported to this country. An analysis of the kernels from one of the Pacific Islands is recorded in the "Agricultural Gazette" of New South Wales for August, 1906, and also in "Agricultural News," Barbados, Oct. 6, 1906—showing "Moisture, 8·23; Albuminoids, 8·04; Oil, 59·93; Fibre, 2·62; Ash, 3·56; Carbohydrates (by difference) including pectous bodies."

The nuts have been submitted to Kew for identification under the names "Mireken Nut" and "Kemiri Nut," as well as the more general one of "Candle Nut." In Ceylon they are known as "Kekuna," and an important paper entitled "Candle Nut (Kekuna) Oil as an Industry" is published in the "Tropical Agriculturist," vol. xlviii., May, 1917, pp. 300-302, urging its cultivation which, as the tree grows so freely, should not be attended with any difficulty. Planting 25 to 30 ft. apart in protected situations up to 2600 ft. above sea-level is recommended, and the tree is said to bear at the end of the second year.

J. H. H.

Strychnos Nux-vomica in Cochin-China.—In *K.B.* 1917, pp. 184, 185, some evidence is given as to the occurence of this species in Cochin-China in the wild state. Since the account was written a letter and a packet of undoubted *Nux-vomica* seeds have been received from the Director, Agricultural and Commercial Services, Cochin-China, with the information that the seeds were obtained from trees growing wild in the country.

H.B.M.'s Consul, Saigon, also sends the following information about *S. Nux-vomica* in Cochin-China which he has received from Monsieur Morange, Director of the Agricultural and Commercial Services of Cochin-China, and also a sample of the seeds obtained from a Chinese exporter.

The tree exists in the Eastern provinces of Cochin-China, principally in the forests of Baria. The seeds are bought by Chinese from the savage tribes known as Mois, who collect them in the forest; the Chinese then export them to China or sell them again to firms exporting to Europe. The time of fruiting is in November and December. M. Morange considers that the tree is certainly indigenous in Cochin-China, and was not introduced by early traders.

Strychnos psilosperma.—We have received from Mr. J. H. Maiden, F.R.S., Botanic Gardens, Sydney, an excellent set of specimens of this Australian *Strychnos*, showing both the adult and juvenile states, collected by Dr. T. L. Bancroft, in the

Eidsvold District, Queensland. This species forms a shrub from 6-15 ft. high, and on an average about 10 ft. high. In the axils of some of the leaves of the young shoots slender terete spines, about 1 cm. long, are present, which are caducous and are not usually seen in herbarium material. No other specimens at Kew or in other British herbaria show the spines, but they were met with by Mueller, who mentions in his original description that the species is occasionally spinescent. This character is not referred to in *K.B.* 1917, p. 171, but the similar, though longer, spines of the *S. arborea*, which Mr. Maiden informs us is a stout sturdy tree, are figured on p. 172. The figure has been inverted by mistake. A. W. H.

Enneapogon mollis in Ascension Island.—In *K.B.* 1917, p. 217, an account is given of the sudden appearance of this grass in the island. A further letter has now reached us from the Director of Victualling, Admiralty, enclosing the following extract from a later letter received from the Farm Superintendent, giving further particulars about the grass:—

"The grass appeared first in Wide-a-wake Plain—it was probably brought entangled in the feathers of the Sooty Tern, which nest on this Plain in millions about every eight months, and after rearing their young all depart again, either to the West Coast of Africa or elsewhere.

"Being in the strong trades here, the seed only blew from the Plain in a north-westerly direction, covering in a large, fan-like shape to Garrison the intervening land for $3\frac{1}{2}$ miles by 2 miles at the front—behind the Plain, to windward, no grass was growing.

"I have since collected some seed and have sown it to windward in other places and am now awaiting results. The grass first made its appearance in the hot season in February and March, after the heavy tropical rains, which were unusually plentiful this year. It commenced to seed in April and May, and lasted on as green grass till August—the heavy rains end about July, when the grass, which is an annual, commenced to dry off and the ground is at present covered with the dry grass and a great quantity of seed.

"I am now anxious to see what happens after the next heavy rains, which may occur again next year; but I have known five consecutive years with scarcely any heavy rain on the lower levels of the island, up to 1000 ft.

"Every endeavour should be made to make as much hay as possible if the grass appears again, for the little we made is excellent, and its nature reminds me of hay made in England from Trifolium."

Bark-peeling of Plane Trees.—A phenomenon which has been very noticeable this year, both in this country and in France, is the excessive peeling of the bark from the trunk and main branches of the common plane—*Platanus acerifolia*. During the high winds of October the ground in the neighbourhood of plane

trees was strewn with flakes, not only numerous, but unusually large. In France, where the peeling commenced in July, flakes of bark have been observed to be occasionally as much as 6 ft. in length. It is many years since our plane trunks have shown so clean and well-groomed an appearance. The plane, of course, sheds its bark regularly, and what has happened this autumn is that, in addition to the normal release of bark, a future shedding probably has been anticipated. The Boulevards in Paris in particular have presented a remarkable sight with the perfectly clean lemon-yellow, or pale orange trunks and branches of the freshly-stripped trees. In attempting to account for this decortication there are two circumstances that suggest themselves as having possibly some connection with it. These are the severity of the winter and early spring of 1916-1917, and the especially good growing weather of the past summer. The winter frosts may have loosened the hold of the outer bark. Certainly the favourable summer of 1917 must have induced an unusual expansion of the trunk, and this would, of course, also help towards the detachment of the outside and effete layer of bark. It can be noticed that the trunks, as a general rule, but with exceptions, are at present more denuded of bark on the south side than on the north. This may be due to the influence of the sun, or to that side being more exposed to strong winds, or to both.

Plant Materials of Decorative Gardening.*—We have received a copy of a little work bearing this title from the author, Prof. Trelease, of the University of Illinois. It is an attempt to make it possible for any careful observer to learn the generic and usually the specific name of any hardy tree, shrub, or woody climber that he is likely to find cultivated in the Eastern United States—apart from the extreme south—or in Northern Europe, anywhere except on the more pretentious estates, or in nurseries or botanical establishments. The volume is a thin one, measures only 6 in. by $4\frac{1}{2}$ in., and is composed of 204 pages. It is, therefore, of very convenient pocket size. Making allowance for its dimensions, we consider the book very creditably achieves its aim. The keys are arranged on the dichotomous system, and as regards the genera, we find they work very well. And for the gardens of Eastern North America, the keys of species, no doubt, are equally useful. But for this country, where the number of cultivated trees and shrubs is much greater, we find the lists of species, especially of the more important genera, often too meagre to fulfil their purpose. Of *Cotoneaster*, for instance, six species only are "keyed," of which but one, *C. microphylla*, is commonly grown in our gardens. Such common species as *C. frigida*, *C. horizontalis*, *C. bacillaris and C. Simonsii* are not mentioned. Of *Elaeagnus*, again, the evergreen and most popular species, are not included. In spite of this, however, the book is

* Plant materials of Decorative Gardening—The Woody Plants. By William Trelease, Professor of Botany in the University of Illinois. Published by the Author. Urbana. 1917.

a very valuable one, and contains a remarkable amount of information compressed in small space. The key to the genera of woody plants is especially useful, and it is supplemented in the body of the work by a concise and accurate description of each genus. W. J. B.

Botanical Magazine.—The following plants are figured in the numbers for July, August and September:—*Pinus tuberculata*, Gord. (t. 8717) from Western North America; *Odontoglossum platycheilum*, Weathers (t. 8718) from Guatemala; *Oreocharis Forrestii*, Skan (t. 8719) a native of North-Western Yunnan; *Sinofranchetia chinensis*, Hemsl. (t. 8720) from Western Hupeh and Szechuan; *Rhododendron Cuffeanum*, Craib (t. 8721) from Upper Burma; *Berberis aggregata*, Schneider (t. 8722) a native of Western China; *Bulbophyllum lilacinum*, Ridl. (t. 8723) from the Malay Peninsula and Siam; *Polygonum Griffithii*, Hook. f. (t. 8724) from Northern India and Western China; *Odonotoglossum chiriquense*, Reichb. f. (t. 8725) from Costa Rica and Colombia; *Oresitrophe rupifraga*, Bunge (t. 8726) from North China: *Rhododendron neriiflorum*, Franch. (t. 8727) from Yunnan, and *Aster fuscesens*, Bur. et Franch. (t. 8728) from Western China.

In the numbers for October, November and December the following plants are figured:—*Pleione Pricei*, Rolfe (t. 8729) a native of Formosa; *Castilleja miniata*, Dougl. (t. 8730) from Western North America; *Orthrosanthus Chimboracensis*, Baker (t. 8731) extending from Mexico to Peru; *Daphne Giraldii*, Nitsche (t. 8732) from China; *Prunus subhirtella* var. *autumnalis*, Makino (t. 8733) from Japan; *Megacarpaea polyandra*, Benth. (t. 8734) from the Himalaya; *Primula nutans*, Delavay (t. 8735) from Yunnan; *Rhododendron Fargesii*, Franch. (t. 8736) from China; *Sarcochilus solomonensis*, Rolfe (t. 8737) a native of the Solomon Islands; *Sechium edule*, Sw. (t. 8738) from Tropical America; *Syringa Wilsonii*, Schneider (t. 8739) from Western Szechuan; *Cryptophoranthus Dayanus*. Rolfe (t. 8740) from Colombia and *Grevillea oleioides*, Sieb. (t. 8741)), a native of New South Wales.

The volume for the year is dedicated to Mr. R. I. Lynch. Curator, Botanic Garden, Cambridge.

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ROYAL BOTANIC GARDENS, KEW.

BULLETIN

OF

MISCELLANEOUS INFORMATION.

APPENDIX I.—1917.

LIST OF SEEDS OF HARDY HERBACEOUS PLANTS AND OF TREES AND SHRUBS.

The following is a select list of seeds of Hardy Herbaceous Plants and of Hardy Trees and Shrubs which, for the most part, have ripened at Kew during the year 1916. These seeds are available only for exchange with Botanic Gardens, as well as with regular correspondents of Kew. No application, except from remote colonial possessions, can be entertained after the end of February.

HERBACEOUS PLANTS.

Acaena glaucophylla.
inermis.
macrostemon.
microphylla.
myriophylla.
Novae-Zelandiae.
ovalifolia.

Acanthus pubescens.

Achillea ageratifolia.
argentea.
Clavennae.
Gerberi.
Kellereri.
tomentosa.
Wilczeckii.

Aconitum barbatum.
Kusnezoffi.
Lycoctonum.
moldavicum.
uncinatum.
Wilsoni.

Adenophora liliifolia.
ornata.
stylosa.

Aethionema cappadocicum.
cordatum.
iberideum.
lacerum.
pulchellum.
saxatile.

(4681.) Wt. 71—728. 1,250. 12/16. J. T. & S. G. 14.

Agrostis alba.
elegans.
nebulosa.

Allium atropurpureum.
grande.
kansuense.
karataviense.
macranthum.
neapolitanum.
odorum.
Ostrowskyanum.
polyphyllum.
pulchellum.
Schuberti.
subhirsutum.

Alonsoa Warscewiczii.

Alstroemeria aurantiaca.
Ligtu.

Althaea armeniaca.
cannabina.
ficifolia.
kurdica.
pallida.
rosea.

Alyssum amanum.
creticum.
incanum.
podolicum.
saxatile var. citrinum.
serpyllifolium.
sinuatum.
spinosum.

Amarantus caudatus.
chlorostachys.
hypochondriacus.
polygamus.
retroflexus.

Amellus annuus.

Amethystea coerulea.

Ammobium alatum.

Anacyclus officinarum.

Androsace lactiflora.
villosa.

Anemone alpina.
decapetala.
multifida.
pratense.
Pulsatilla.
rivularis.
sylvestris.

Anthemis mixta.
montana.
tinctoria.

Anthericum Liliago.
ramosum.

Antirrhinum hispanicum.
Orontium.

Apera Spica-Venti.

Aquilegia canadensis.
chrysantha.
coerulea.
flabellata.
glandulosa.
pyrenaica.
truncata.

Arabis arenosa.
verna.

Arctotis stoechadifolia.

Arenaria capillaris.
cephalotes.
foliosa.
gypsophiloides.
grandiflora.
montana.
pinifolia.
purpurascens.
sajanensis.

Argemone alba.
hispida.
mexicana.
ochroleuca.

Armeria canescens.
chilensis.
fasciculata.
majellensis.

Arnica latifolia.
longifolia.
sachalinensis.

Asperula azurea.
galioides.

Asphodeline lutea.

Asphodelus albus.

Aster alpinus.
batangensis.
Douglasii.
foliaceus.
fuscescens.
Lipskyi.
oreophilus.
Purdomi.
subcceruleus.
vestitus.

Astilbe chinensis.
rivularis.
Thunbergii.

Astragalus arcticus.
frigidus.
Glyciphyllos.
maximus.
pentaglottis.
stipulatus.
xiphocarpus.

Astrantia helleborifolia.

Athamanta Matthioli.

Atriplex rosea.

Atropa Belladonna.
lutescens.

Barbarea arcuata.

Beckmannia erucaeformis.

Bellium crassifolium.

Berkheya purpurea.

Bidens leucantha.

Biscutella ciliata.
didyma.
laevigata.

Blumenbachia insignis.

Bocconia cordata.
microcarpa.

Brachypodium caespitosum.
japonicum.

Brassica campestris.
Erucastrum.
juncea.
rugosa.
Tourneforti.

Brickellia grandiflora.

Briza maxima.
minor.

Bromus ciliatus.
japonicus.
maximus.
rubens.
squarrosus.
unioloides.

Bulbinella Hookeri.

Buphthalmum salicifolium.

Bupleurum Candollei.
longifolium.
sachalinense.

Cakile maritima.

Calamagrostis Epigeios.

Calandrinia speciosa.

Callirhoë involucrata.
lineariloba.
pedata.

Callistephus hortensis.

Camassia Fraseri.
Leichtlinii.
montana.

Camelina sativa.

Campanula barbata.
bononiensis.
Cervicaria.
Imeretina.
Kolenatiana.
lactiflora.
lanata.
latifolia.
latiloba.
lingulata.
macrostyla.
patula.
phyctidocalyx.
pulla.
rhomboidalis.
Scheuchzeri.
serotina.
speciosa.
thyrsoides.
thyrsoides × spicata.

Capsella grandiflora.

Carbenia benedicta.

Carduus tenuiflorus.

Carex binervis.
laevigata.

Carthamus lanatus.
tinctorius.

Carum copticum.

Catananche coerulea.
lutea.

Cathcartia villosa.

Centaurea axillaris.
dealbata.
montana.
Phrygia.
rupestris.

Centranthus Sibthorpii.

Cephalaria radiata.

Cerastium Biebersteinii.
macranthum.
tomentosum.

Chaerophyllum aromaticum.
nodosum.

Charieis heterophylla.

Chelone Lyoni.
obliqua.

Chelonopsis moschata.

Chenopodium ambrosoides.
capitatum.
urbicum.

Chlorogalum pomeridianum.

Chorispora tenella.

Chrysanthemum carinatum.
caucasicum.
ceratophylloides.
cinerariaefolium.
coronarium.
corymbosum.
Haussknechtii.
Myconis.
pallens.

Clarkia elegans.
pulchella.

Cnicus Eriophorum.
syriacus.

Collinsia bicolor.
grandiflora.

Collomia gilioides.
grandiflora.

Convolvulus Cupanianus.
undulatus.

Coreopsis lanceolata.

Coriandrum sativum.

Coronilla scorpioides.

Corydalis capnoides.
glauca.
lutea.
racemosa.

Corynephorus canescens.

Cosmidium Burridgeanum.

Crepis aurea.
blattarioides.
grandiflora.
pygmaea.
rubra.

Crocus asturicus.
medius.

Crucianella aegyptiaca.

Cynoglossum coelestinum.
nervosum.
Wallichii

Dactylis altaica.

Dahlia variabilis.

Datura Tatula.

Delphinium Bulleyanum.
caucasicum.
consolida.
decorum.
Delavayi.
elatum.
Geyeri.
grandiflorum.
Maackianum.
Menziesii.
occidentale.
pictum.
speciosum.
— var. glabratum.
vestitum.

Deschampsia caespitosa.
tenella.

Deyeuxia Langsdorfii.

Dianthus arenarius.
Armeria.
caesius.
capitatus.
Caryophyllus.
cruentus.
deltoides.
fragrans.
frigidus.
gallicus.
giganteus.
leptopetalus.
neglectus.
pallidiflorus.
petraeus.
Seguieri.
squarrosus.
subacaulis.
superbus.
viscidus.
Waldsteinii.

Dictamnus albus.

Digitalis ambigua.

Dimorphotheca aurantiaca.
hybrida.
pluvialis.

Dipsacus asper.
atratus.
inermis.

Dodecatheon frigidum.
Meadia.

Downingia elegans.

Draba aizoides.
Bertolonii.
carinthiaca.
cuspidata.
fladnizensis.
frigida.
incana.
nivalis.
rigida.
Salomonii.

Dracocephalum Moldavica.
nutans.
parviflorum.

Dryas Drummondii.
lanata.

Echinops dahuricus.
sphaerocephalus.

Elymus giganteus.
virginicus.

Encelia calva.

Epilobium crassum.
Dodonaei.
luteum.

Epipactis palustris.

Eragrostis abyssinica.

Eranthis cilicica.

Eremostachys laciniata.

Eremurus himalaicus.
robustus.
Tubergeni.

Erigeron alpinus.
aurantiacus.
glabellus.
grandiflorus.
multiradiatus.
salsuginosus.
uniflorus.

Erinus alpinus.

Erodium amanum.
Botrys.
gruinum.
macradenum.
Manescavii.
supracanum.
trichomanefolium.

Eryngium alpinum.
Bourgati.
spinalba.

Erysimum Perofskianum.
rupestre.

Erythraea Massoni.

Erythronium californicum.
revolutum.

Eschscholzia caespitosa.
californica.
Douglasii.

Eucharidium Breweri.
concinnum.

Festuca heterophylla.
Myuros.
Poa.
rigida.
vaginata.

Fragaria indica.

Francoa appendiculata.
ramosa.

Fritillaria citrina.
lutea.
pallidiflora.
tenella.

Galactites tomentosa.

Galax aphylla.

Galega orientalis.
patula.

Galeopsis Tetrahit.

Galium thymifolium.

Gastridium australe.

Gentiana asclepiadea.
crassicaulis.
Cruciata.
decumbens.
lutea.
macrophylla.
phlogifolia.
septemfida.
straminea.
tibetica.

Geranium albiflorum.
Fremonti.
grandiflorum.
ibericum.
incisum.
macrorrhizum.
rivulare.
sessiliflorum.
tuberosum.

Gerbera Anandria.

Geum bulgaricum
chiloense.
Heldreichii.
montanum.
Rossii.
triflorum.

Gilia achilleaefolia.
androsacea.
capitata.
densiflora.
liniflora.
micrantha.
multicaulis.
squarrosa.
tricolor.

Gillenia trifoliata.

Glaucium corniculatum.
—var. tricolor.

Globularia cordifolia.
vulgaris.

Glyceria distans.

Grindelia cuneifolia.
robusta.

Guizotia oleifera.

Gypsophila elegans.
muralis.
Steveni.

Hastingsia alba.

Hebenstretia tenuifolia.

Hedysarum esculentum.
flavescens.
Semenovii.

Helenium Bigelovii.
Hoopesii.
tenuifolium.

Helianthemum Tuberaria.

Helianthus Nuttallii.
occidentalis.

Helichrysum bracteatum.

Helipterum roseum.

Heracleum persicum.
pyrenaicum.

Herbertia pulchella.

Hesperis matronalis.

Heuchera Drummondi.

Hibiscus Trionum.

Hieracium alpinum.
Bornmülleri.
cappadocicum.
Heldreichii.
Jankae.
pannosum.
villosum.

Hilaria rigida.

Hordeum bulbosum.
maritimum.

Horminum pyrenaicum.

Hymenophysa pubescens.

Hyoscyamus albus.

Hypecoum grandiflorum.
procumbens.

Hypericum Ascyrum.
confertum.
Coris.
empetrifolium.
linarifolium.
nummularium.
olympicum.

Hypochaeris glabra.

Iberis Amara.
Lagascana.

Impatiens scabrida.

Inula barbata.
ensifolia.
Hookeri.
macrocephala.
orientalis.
racemosa.
Royleana.
spiraeafolia.

Iris bucharica.
caroliniana.
chrysographis.
dichotoma.
longipetala.
setosa.

Isatis glauca.

Jasione perennis.

Juncus alpinus.
Chamissonis.

Jurinia cyanoides.

Kitaibelia vitifolia.

Kniphofia citrina.
Nelsoni.

Kochia trichophila.

Koeleria phleoides.
splendens.

Lactuca perennis.

Lagurus ovatus.

Lallemantia canescens.

Lasiospermum radiatum.

Lathyrus angulatus.
Aphaca.
articulatus.
cirrhosus.
laxiflorus.
luteus.
maritimus.
Nissolia.
Ochrus.
pisiformis.
polyanthus.
rotundifolius.
setifolius.
tingitanus.
tuberosus.
undulatus.
variegatus.
venosus.

Laurentia tenella.

Lavatera cachemiriana.

Leontopodium alpinum.

Leptosyne Douglasii.
maritima.
Stillmanni.

Leuzea conifera.
longifolia.

Ligusticum alatum.
pyrenaicum.
scoticum.

Limnanthes alba.

Linaria aparinoides.
bipartita.
dalmatica.
macedonica.
maroccana.
multipunctata.
saxatilis.
triphylla.
tristis.
viscida.

Linum angustifolium.
capitatum.
monogynum.
nervosum.
usitatissimum.

Lotus Requienii.
Tetragonolobus.

Lunaria annua.

Lupinus concinnus.
Douglasii.
elegans.
micranthus.
mutabilis.
nanus.
perennis.
pubescens.

Luzula Hosti.
nivea.

Lychnis Delavayi.
Flos-jovis.
fulgens.
Haageana.
Lagascae.
Preslii.
Sartori.

Lycurus phleoides.

Lysimachia clethroides.

Madia dissitiflora.
sativa.

Malcomia chia.
maritima.

Malope trifida.

Malva Alcea.
oxyloba.
parviflora.

Matthiola bicornis.
sinuata var. glabra
albiflora.

Meconopsis aculeata.
cambrica.
heterophylla.
paniculata.
rudis.
simplicifolia.
Wallichii.

Medicago Helix.
Murex.
orbicularis.
turbinata.

Melica altissima.
ciliata.

Melilotus alba.

Mirabilis divaricata.
Jalapa.

Molinia coerulea.

Molopospermum cicutarium.

Monarda didyma.
fistulosa.

Monolepis trifida.

Muscari armeniacum.
compactum.
neglectum.
paradoxum.
parviflorum.
pulchellum.

Myosurus minimus.

Myriactis Gmelini.

Nardus stricta.

Nemesia floribunda.

Nicandra physaloides.

Nicotiana affinis.
Langsdorffii.
paniculata.
rustica.
Sanderae.
Tabacum.

Nigella corniculata.
damascena.
hispanica.

Noccaea alpina.

Oenothera amoena.
densiflora.
rosea.
tenella.
triloba.

Ornithogalum narbonense.

Oxytropis baicalensis.
ochroleuca.
pilosa.

Paeonia Brownii.
decora var. alba.
mollis.
paradoxa.
peregrina.
tenuifolia.

Panicum capillare.

Papaver alpinum.
Argemone.
commutatum.
glaucum.
laevigatum.
lateritium.
nudicaule.
orientale.
pavoninum.
rupifragum.
somniferum.

Paradisia Liliastrum.

Parrya Menziesii.

Patrinia heterophylla.
palmata.

Peltaria alliacea

Pennisetum macrourum.

Pentstemon acuminatus.
arizonicus.
barbatus.
campanulatus.
confertus.
deustus.
diffusus.
glaucus.
gracilis.
heterophyllus.
humilis.
isophyllus.
Jamesii.
Lobbi.
Menziesii var. Scouleri.
ovatus.
pubescens.
secundiflorus.

Perezia multiflora.

Petunia nyctaginiflora.

Phalaris paradoxa.
tuberosa.

Phleum arenarium.
asperum.
Michelii.

Phlomis pratensis.
tuberosa.
umbrosa.

Physalis Alkekengi.
Bunyardi.
Francheti.

Physochlaina orientalis.

Physospermum cornubiense.

Physostegia virginiana.

Phyteuma Michelii.
orbiculare.
Scheuchzeri.
spicatum.

Phytolacca acinosa.
decandra.

Plantago Candollei.
Coronopus.
Cynops.
maritima.
Myosurus.
Psyllium.

Platycodon grandiflorum.
— var. Mariesii.

Platystemon californicus.

Pleurospermum Golaka.

Poa caesia.
violacea.

Podophyllum Emodi.

Polemonium mexicanum.
pauciflorum.

Polygonum affine.
viviparum.

Polypogon littoralis.
monspeliensis.

Portulaca grandiflora.

Potentilla argyrophylla.
calycina.
crinita.
dealbata.
glandulosa.
gracilis.
Herbichii.
Meyeri.
montenegrina.
multifida.
nepalensis.
nevadensis.
pennsylvanica.
recta.
rivale.
rupestris.
semilaciniata.
sericea.
tanacetifolia.

Pratia angulata.

Prenanthes altissima.

Preslia cervina.

Primula Beesiana.
Bulleyana.
capitata.
Cockburniana.
frondosa.
Giraldiana.
involucrata.
Littoniana.
malacoides.
pseudo-sikkimensis.
pulverulenta.
rosea.
saxatilis.
Smithiana.
verticillata.

Psoralea acaulis.
macrostachya.
physodes.

Ramondia pyrenaica.

Ranunculus chaerophyllus.
Nyssanus.

Reseda virgata.

Rhagadiolus edulis.

Rheum acuminatum.
nobile.
Webbianum.

Rodgersia aesculifolia.
pinnata.
podophylla.

Roemeria hybrida.

Romulea candida.
speciosa.

Rudbeckia amplexicaulis.
californica.
speciosa.
subtomentosa.

Rumex maximus.
sanguineus.

Salvia argentea.
Bertolonii.
Columbariae.
glutinosa.
grandiflora.
Horminum.
Schiedeana.
uliginosa.
verticillata.
virgata.

Saponaria Vaccaria.

Saussurea albescens.
hypoleuca.
salicifolia.

Saxifraga caespitosa.
cartilaginea.
cochlearis.
— var. minor.
decipiens.
Delavayi.
granulata.
Hausmanni.
Hirculus.
latepetiolata.
lingulata.
— var. lantoscana.
luteo-viridis.
montavoniensis.
mutata.
pedemontana.
rotundifolia.
Stribrnyi.

Scabiosa caucasica var. connata.
graminifolia.
gramuntia.
Kitaibelii.
longifolia.
vestina.

Scilla autumnalis.
verna.

Scopolia lurida.
sinensis

Scrophularia nodosa.
Scorodonia.

Sedum altissimum.
Ewersii.
heterodontum.
kamtschaticum.
maximum.
rhodanthum.
spathulifolium.
ternatum.

Selinum serbicum.
vaginatum.

Senecio abrotanifolium.
adonidifolium.
alpinus.
Clivorum.
Doronicum.
elegans.
Ledebouri.
Ligularia
squalidus.
stenocephalus.

Serratula atriplicifolia.
Gmelinii.
quinquefolia.
tinctoria.

Seseli elatum.
glaucum.

Setaria glauca.
italica.

Sidalcea candida.
Listeri.
malvaeflora.
neo-mexicana.

Siderites scordiodes.

Siegesbeckia orientalis.

Silene alpestris.
Armeria.
asterias.
colorata.
conoidea.
cretica.
Delavayi.
echinata.
elegans.
Fortunei.

Silene—*cont.*
italica.
linicola.
longicilia.
melandrioides.
Muscipula.
noctiflora.
nocturna.
paradoxa.
pendula.
quadrifida.
Reichenbachii.
rupestris.
Saxifraga.
Sendtneri.
squamigera.
tenuis.
thessalonica.
vallesia.
verecunda.
Zawadskii.

Silybum eburneum.
Marianum.

Sisymbrium strictissimum.

Smyrnium Olusatrum.

Specularia pentagonia.
perfoliata.
Speculum.

Spiraea digitata.
palmata.

Stachys Alopecuros.
citrina.
graeca.
grandiflora.

Statice bellidifolia.
latifolia.
Suwarowii.
tatarica.

Stipa Calamagrostis.
papposa.
pennata.

Swertia longifolia.
perennis.

Symphyandra Hofmanni.
Wanneri.

Tellima grandiflora.

Thalictrum aquilegifolium.
corynellum.
cultratum.
squarrosum.

Thermopsis fabacea.
lanceolata.

Thlaspi densiflorum.

Thymus odoratissimus.

Trautvetteria palmata.

Tricholepis furcata.

Trifolium elegans.
incarnatum.
Lupinaster.
ochroleucum.
pannonicum.
parviflorum.

Trigonella coerulea.
corniculata.
cretica.
polycerata.
radiata.

Trillium grandiflorum.

Trollius altaicus.
asiaticus.
sinensis.

Troximon grandiflorum.

Tulipa Batalini.
chrysantha.
dasystemon.
Kaufmanniana.
linifolia.
Sprengeri.

Ursinia pulchra.

Urtica pilulifera.

Valerianella carinata.
dentata.
echinata.
eriocarpa.
vesicaria.

Verbascum olympicum.
phoeniceum.

Verbena bonariensis.
erinoides.

Verbesina helianthoides.
Purpusii.

Veronica austriaca.
gentianoides.
incana.
saxatilis.
spicata.
virginica.
— var. japonica.

Vesicaria utriculata.

Vicia angustifolia,
calcarata.
melanops.
Orobus.
pyrenaica.
unijuga.

Vincetoxicum fuscatum.

Viola cornuta.
gracilis.
persicifolia.

Xanthocephalum gymnospermoides.

Zygadenus elegans.

TREES AND SHRUBS.

Those marked with an asterisk were not grown at Kew.

*Abies Mariesii.
*sachalinensis.
*— var. nemorensis.
*umbellata.
*Veitchii var. olivacea.

Acanthopanax divaricatum.
sessiliflorum.

Acer circinatum.
dasycarpum.
glabrum.
Heldreichii.
hyrcanum.
insigne.
macrophyllum.
micranthum.
monspessulanum.
opulifolium.
tetramerum.
Tschonoskii.

Adenocarpus foliolosus.

Aesculus indica.

Ailanthus glandulosa.

Alnus barbata.
cordifolia.
elliptica.
firma.
incana.
japonica.
nitida.
oregona.
orientalis.
serrulata.
sitchensis.
Spaethii.
subcordata.
tenuifolia.
viridis.

Amelanchier asiatica.
vulgaris.

Aralia chinensis.
— var. pyramidalis.

Arctostaphylos tomentosa.

*Ardisia crispa.

Berberis acuminata.
aggregrata.
angulosa.
Aquifolium.
aristata.
concinna.
Darwinii.
diaphana.
dubia.
Gagnepainii.
Giraldi.
Guimpelii.
Hookeri var. viridis.
orthobotrys.
pachyacantha.
polyantha.
Prattii.
sanguinea.
Sargentiana.
sinensis.
Stapfiana.
subcaulialata.
Thunbergii.
umbellata.
Vilmoriniana.
Wilsonae.
yunnanense.

Betula.
alnoides var. pyrifolia.
coerulea.
Ermani.
— var. nipponica.
fruticosa.
humilis.
Kenaica.
lenta.
lutea.
Medwediewii.
occidentalis.

Betula—*cont.*
papyrifera.
populifolia.
pumila.
utilis.
— var. Jacquemontii.

Bruckenthalia spiculifolia.

Buddleia albiflora.
japonica.
nivea.
variabilis.
— var. Veitchiana.

Caragana arborescens.
— var. Redowskii.
aurantiaca.
decorticans.
frutescens.
microphylla.

Carmichaelia australis.
flagelliformis.

Carpinus caroliniana.
*cordata.
orientalis.
polyneura.

Cassinia fulvida.
Vauvilliersii.

Ceanothus americanus.
azureus.
integerrimus.
papillosus.
thyrsiflorus.

Celastrus articulatus.
flagellaris.
scandens.

Celtis occidentalis.

Cephalotaxus drupacea.
Fortuni.
pedunculata.

*Cercis occidentalis.
Siliquastrum.

Chionanthus virginica.

Cistus albidus.
creticus.
crispus.
hirsutus.
laurifolius.
platysepalus.
populifolius.
purpureus.
salvifolius.
tauricus.
vaginatus.

Cladothamnus pyrolaeflorus.

Cladrastis amurensis.

Clematis aethusifolia var.
latisecta.
akebioides.
connata.
— var. velutina.
Fargesii.
Flammula.
fusca.
grata.
heracleaefolia.
integrifolia.
ligusticifolia.
mandshurica.
montana.
— var. rubens.
nutans.
orientalis.
Pitcheri.
Rehderiana.
Scottii.
Spooneri.
tangutica.
Veitchiana.
virginiana.

Clerodendron Fargesii.
trichotomum.

Clethra alnifolia.
*canescens.

Colutea arborescens.
bullata.
cilicica.
longialata.

Colutea—*cont.*
media.
orientalis.

Coriaria japonica.

Cornus alba.
Amomum.
asperifolia.
Bretschneideri.
candidissima.
macrophylla.
pubescens.
Purpusi.

Cotoneaster acutifolia.
— var. villosula.
affinis.
amoena.
apiculata.
applanata.
bacillaris.
— var. obtusata.
bullata.
buxifolia.
divaricata.
Fontanesii.
foveolata.
Franchetii.
frigida.
Harroviana.
Henryana.
horizontalis.
integerrima.
laxiflora.
Lindleyi.
lucida.
microphylla.
multiflora.
Nummularia.
obscura.
pannosa.
*racemiflora var. songorica.
rotundifolia.
salicifolia var. rugosa.
Simonsii.
thymifolia.
tomentosa.
uniflora.
Zabelii.

Crataegus acclivis.
altaica.

Crataegus—*cont.*
atrorubens.
Buckleyi.
Carrierei.
chlorosarca.
coccinea.
cordata.
Dippeliana.
dsungarica.
durobrivensis.
elongata.
flava.
Jackii.
melanocarpa.
modesta.
orientalis.
Peckii.
pentagyna.
pinnatifida.
prunifolia.
pubescens var. stipulacea.
tanacetifolia.
tomentosa.
Vailiae.

Cupressus Benthami var.
arizonica.
glabra.
Goveniana.
Lawsoniana.
macrocarpa.
nootkatensis.
sempervirens.
— var. retrofracta.
thyoides.
torulosa.

Cydonia Maulei.

Cytisus albus.
biflorus.
capitatus.
Heuffeli.
horniflorus.
nigricans.
purgans.
purpureus.
Rochelii.
scoparius var. Andreanus.
— var. flore albo.
sessilifolius.
syriacus.

Daboëcia polifolia.

Daphne Mezereum.
— var. alba.

Desmodium cinerascens.
tiliaefolium.

Deutzia corymbosa.
crenata.
discolor var. purpurascens.
globosa.
longifolia.
— var. Veitchii.
macrocephala.
planifolia.
reflexa.
Sieboldiana.
Vilmoriniana.
Wilsonii.

Diervilla rivularis.
sessilifolia.

Diospyros Lotus.

Dipelta ventricosa.

Distylium racemosum.

Elaeagnus multiflora.
umbellata.

Eleutherococcus Henryi.
leucorrhizus.
— var. fulvescens.
scaberulus.
Simonii.

Elsholtzia Stauntoni.

Enkianthus campanulatus.
cernuus.
himalaicus.

Erica cinerea.
Mackaii.
scoparia.
stricta.

Escallonia Balfourii.
littoralis.

Euonymus americanus.
Bungeanus.
Hamiltonianus.
latifolius.
oxyphyllus.
planipes.
ussuriensis.
yedoensis.

Evodia hupehensis.

Fatsia horrida.
japonica.

Fraxinus Ornus.

Garrya elliptica.

Gaultheria procumbens.
Shallon.

Genista aethnensis.
germanica.
hispanica.
pilosa.
radiata.
sagittalis.
tinctoria.
— var. elatior.
virgata.

Halesia hispida.
tetraptera.

Hamamelis arborea.
japonica.
— var. Zuccariniana.
mollis.

Hedysarum multijugum.

Helianthemum alyssoides.
formosum.
halimifolium.
polifolium.
Tuberaria.
villosum.

Hippophaë rhamnoides.

Hydrangea aspera.
Bretschneideri.
cinerea.

Hydrangea—*cont.*
paniculata.
petiolaris.
radiata.
vestita.
xanthoneura.
— var. glabrescens.
— var. Wilsoni.

Hypericum Androsaemum.
aureum.
Buckleyi.
elatum.
Hookerianum.
inodorum.
patulum.
— var. Henryi.
perforatum
prolificum.
Richeri.

Ilex opaca.
verticillata.

Indigofera Gerardiana.
macrostachya.

Jamesia americana.

Jasminum fruticans.
humile.

Kalmia cuneata.
glauca.
latifolia.
— var. myrtifolia.

*Larix dahurica var. japonica.
*Principii Rupprechtii.

Laurus nobilis var. angustifolia.

Ledum latifolium.
palustre.

Lespedeza bicolor.

Leycesteria formosa.

Ligustrum Delavayanum.
insulare.
medium.

Lonicera alpigena.
chrysantha.
deflexicalyx.
dioica.
Henryi.
iberica.
involucrata.
— var. Ledebourii.
Maackii.
minutiflora.
Morrowi.
nigra.
obovata.
orientalis.
ovalis.
prostrata.
segreziensis.
Sullivantii.
tatarica.
translucens.
Xylosteum.

Lupinus arboreus.

Lycium chinense.
— var. carnosum.
pallidum.

Lyonia ligustrina.

Menziesia globularis.

Microglossa albescens.

Myricaria germanica.

Neillia amurensis.
capitata.
opulifolia.
Ramuleyi.
stellata.
Torreyi.

Nesaea salicifolia.

Notospartium Carmichaeliae.

Nuttallia cerasiformis.

Olearia Haastii.
odorata.

Ononis fruticosa.
rotundifolia.

*Ostrya japonica.

Paliurus australis.

Pernettya mucronata.

Pertya sinensis.

Petteria ramentacea.

Phellodendron amurense.
chinense.

Philadelphus acuminatus.
brachybotrys.
— var. purpurascens.
californicus.
Gordonianus.
latifolius.
Lewisii.
Magdalenae.
Satsumi.
sericanthus.
tomentosus.
Wilsonii.

Phillyraea angustifolia.

*Picea Glehnii.
*Koyamai.

Pieris floribunda.
formosa.
japonica.
mariana.

Platanus acerifolia.
orientalis.

Potentilla fruticosa.

Prunus acida var. semperflorens.
cornuta.
japonica.
Maximowiczii.

Ptelea isophylla.
trifoliata.

*Pueraria Thunbergiana.

Pyracantha angustifolia.
coccinea.
crenulata.
Rogersiana.
— var. fructu luteo.

Pyrus alnifolia.
alpina.
americana.
amygdaliformis.
arbutifolia.
crataegifolia.
decurrens.
elaeagrifolia.
hybrida.
intermedia.
Koehneana.
lobata.
Meinichii.
microphylla.
minima.
Niedzwetzkyana.
nigra.
pekinensis.
pinnatifida.
prunifolia.
Ringo.
rotundifolia.
salicifolia.
sambucifolia.
Sargentii.
scalaris.
setschwanensis.
sorbifolia.
Sorbus.
Toringo.
Vilmorinii.
Zumi.

Raphiolepis japonica.

Rhamnus cathartica.
davurica.
fallax.
Frangula.
spathulifolia.

Rhododendron ambiguum.
brachycarpum.
californicum.
chartophyllum.
concinnum.
Davidsonianum.

Rhododendron—*cont.*
decorum.
*dilatatum.
discolor.
Fargesii.
ferrugineum.
halense.
hirsutum.
lepidotum.
maximum.
Metternichii.
— var. angustifolium.
micranthum.
oreotrephes.
polylepis.
punctatum.
*quinquefolium var. album.
racemosum.
Rhodora.
rhombicum.
rubiginosum.
*semibarbatum.
siderophyllum.
Souliei.
Vaseyi.
villosum.
viscosum.
xanthinum.
yunnanense.

Rhodotypos kerrioides.

Ribes alpinum.
cruentum.
divaricatum.
holosericeum.
robustum.
rotundifolium.
stenocarpum.

*Rosa alpina.
coruscans.
Davidii.
elegantula.
Helenae.
Hugonis.
lucens.
Luciae.
macrophylla.
microphylla.
Moyesii.
omiensis.
— var. pteracantha.

Rosa—*cont.*
pisocarpa.
rubrifolia.
sericea.
sertata.
setipoda.
sicula.
Soulieana.
spinulifolia.
Sweginzowii.
Webbiana.
Willmottiae.
Woodsii.

Rubus adenophorus.
biflorus var. quinqueflorus.
coreanus.
flosculosus.
Giraldianus.
inopertus.
lasiostylus.
— var. dizygos.
mesogaeus.
nigro-baccus.
nutkanus.
occidentalis.
omiensis.
parvifolius.
phoenicolasius.
pubescens.
Swinhoei.
thibetanus.
Thunbergi var. glabellus.
trianthus.
Veitchii.
xanthocarpus.

Ruta graveolens.

*Schizophragma hydrangeoides.

Securinega fluggeoides.
ramiflora.

*Sequoia gigantea.
*sempervirens.

Skimmia japonica.
Laureola.

Smilax Sieboldi.

Sophora flavescens.
viciifolia.

Spartium junceum.

Spiraea Aitchisoni.
arborea.
— var. glabrata.
arcuata.
bella.
betulifolia.
bracteata.
canescens.
chamaedrifolia.
discolor.
fastigiata.
japonica.
laevigata.
Lindleyi.
Nobleana.
nudiflora.
salicifolia.
Sargentiana.
tomentosa.
trilobata.
Veitchii.
Wilsonii.

Staphylea colchica.
Coulombieri.
pinnata.
trifolia.

Styrax japonicum.
Obassia.

Symphoricarpus Heyeri

Syringa Emodi.
Josikaea.
pekinensis.
villosa.

Vaccinium arboreum.
corymbosum.
erythrocarpum.
hirsutum.
neglectum.
padifolium.
pallidum.
simulatum.

Veronica carnosula.

Viburnum brevipes.
betulifolium.
cotinifolium.
dilatatum.
hupehense.
Lantana.
lobophyllum.
ovatifolium.
phlebotrichum.
pubescens.
rhytidophyllum.
theiferum.
venosum.

Zanthoxylum Bungei.

Zenobia speciosa.
— var. pulverulenta

ROYAL BOTANIC GARDENS, KEW.

BULLETIN
OF
MISCELLANEOUS INFORMATION.

APPENDIX II.—1917.

LIST of STAFFS of the ROYAL BOTANIC GARDENS, Kew, and of Botanical Departments, Establishments and Officers at Home, and in India and the Colonies, in Correspondence with Kew.

* Trained at Kew. † Recommended by Kew.

Royal Botanic Gardens, Kew.—

Director - - - - -	Lieut.-Col. Sir David Prain, I.M.S., C.M.G., C.I.E., M.A., M.B., LL.D., F.R.S., P.L.S.
Assistant Director - - -	Arthur W. Hill, M.A., F.L.S.
Assistant, First Class - - -	*John Aikman.
" " " - - -	*William Nicholls Winn.

Keeper of Herbarium and Library	Otto Stapf, Ph.D., F.R.S. F.L.S.
Assistant, First Class - - -	Charles Henry Wright, A.L.S.
" " " - - -	*Robert Allen Rolfe, A.L.S.
" " " - - -	*Sidney Alfred Skan.
" Second Class - -	Thomas Archibald Sprague, B.Sc., F.L.S.
" " " - -	Elsie Maud Wakefield, F.L.S.
" " " - -	*William Bertram Turrill, B.Sc.
" for India - - -	*John Hutchinson.

Assistant, First Class, Pathology Laboratory.	Plant	Arthur Disbrowe Cotton, F.L.S.
" "	"	William Broadhurst Brierley, M.Sc.
" Second Class	"	Mrs. N. L. Alcock.
Assistant Keeper, Jodrell Laboratory.		Leonard Alfred Boodle, F.L.S.

Keeper of Museums - - -	John Masters Hillier.
Assistant, First Class - - -	*John H. Holland, F.L.S.
" Second Class - -	*William Dallimore.
Preparer - - - - -	George Badderly.

(13993—18.) Wt. 152—699. 1125. 11/17. D & S. 17/ 26

Royal Botanic Gardens, Kew—*continued.*

Curator of the Gardens - -	William Watson, A.L.S.
Assistant Curator - - -	*William J. Bean.
Foremen :—	
Herbaceous Department - -	*Walter Irving.
Arboretum - - - -	*Arthur Osborn.
Greenhouse and Ornamental Department.	*John Coutts.
Tropical Department - -	*Charles P. Raffill.
Temperate House - - -	*William Taylor.
Storekeeper - - - -	*George Dear.

Aberdeen.—University Botanic Garden :—

Professor - - -	J. W. H. Trail, M.A., M.D., F.R.S., F.L.S.

Cambridge.—University Botanical Department :—

Professor - - -	A. C. Seward, M.A., F.R.S., F.L.S.
Curator, University Herbarium.	——
Curator, University Museum.	H. H. Thomas, B.A.
Curator of Garden -	*Richard Irwin Lynch, M.A., A.L.S.

Dublin.—Royal Botanic Gardens, Glasnevin :—

Keeper - - -	Sir Frederick W. Moore, M.A., F.L.S.
Assistant - - -	——

Trinity College Botanic Gardens :—

Professor - - -	H. H. Dixon, Sc.D., F.R.S.

Edinburgh.—Royal Botanic Garden :—

Regius Keeper - -	I. B. Balfour, M.A., M.D., LL.D., Sc.D., F.R.S., F.L.S.
Assistant to Regius Keeper.	W. W. Smith, M.A.
Assistant (Museum) -	H. F. Tagg, F.L.S.
,, (Herbarium)	*J. F. Jeffrey.
,, (Laboratory)	M. Y. Orr.
Head Gardener - -	*R. L. Harrow.
Plant Propagator -	L. B. Stewart.
Assistant Gardener -	S. Stewart.
Foremen :—	
Arboretum -	A. Johnstone.
Glass Department	J. J. Campbell.
Herbaceous Department.	——

Glasgow.—Botanic Gardens :—

University Professor -	F. O. Bower, M.A., Sc.D., F.R.S., F.L.S.
Curator - - -	James Whitton.

London.—Chelsea Physic Garden :—

Curator - - -	*W. Hales, A.L.S.

Oxford.—University Botanic Garden :—

Professor - - -	Sydney H. Vines, M.A., Sc.D., F.R.S., F.L.S.
Curator - - -	*William G. Baker.

AFRICA.

Union of South Africa.—

Pretoria.—Department of Agriculture :—		
	Chief, Division of Botany	†I. B. Pole Evans, B.Sc., F.L.S.
	Mycologist - - -	Ethel M. Doidge, D.Sc., F.L.S.
	„ (Herbarium) -	A. B. Bottomley, B.A.
	Botanist („) -	Sydney M. Stent.
	Assistant Botanist - -	A. O. D. Mogg, B.A.
	Chief Conservator of Forests.	C. E. Legat, B.Sc.
Cape Town.—National Botanic Garden :—		
	Director - - - -	——
	Curator - - - -	*J. W. Mathews.
	Gardener - - - -	*A. W. Maynard.
Durban.—Natal Herbarium— :		
	Mycologist in charge -	P. van der Bijl, M.A., F.L.S.

Cape Province.—

Cape Town.—Professor of Botany, South African College.		——
South African Museum Herbarium :—		
	Assistant in charge -	E. P. Phillips, M.A., D.Sc., F.L.S.
	Curator, Bolus Herbarium.	Mrs. F. Bolus.
Gardens and Public Parks :—		
	Superintendent - -	*G. H. Ridley.
Grahamstown.—Albany Museum :—		
	Superintendent of Herbarium.	S. Schönland, Ph.D.
Gardens and Public Parks :—		
Port Elizabeth -	Superintendent - -	John T. Butters.
King Williamstown.	Curator - - -	George Lockie.
Graaff-Reinet -	„ - - -	*C. J. Howlett.
Uitenhage -	„ - -	H. Fairey.

Natal.—

Durban.—Municipal Gardens :—		
	Curator - - -	*James Wylie.
Pietermaritzburg.—Botanic Garden :—		
	Curator - - -	*W. J. Newberry.

Transvaal.—

Pretoria.—Transvaal Museum :—		
	Superintendent of Herbarium - -	Mrs. R. Pott.

British East Africa Protectorate.—

Nairobi - -	Director of Agriculture.	Hon. A. C. Macdonald
	Mycologist - -	†W. J. Dowson, M.A.
	Chief of Economic Plant Division.	*Henry Powell.
	Agricultural Instructor, Coast Region.	G. Farmer.
	Conservator of Forests	E. Battiscombe.

Egypt.—

Cairo.—Ministry of Agriculture :—

Consulting Agriculturist.	Gerald C. Dudgeon F.E.S.
Inspector General -	A. T. McKillop.
Botanist - - -	B. G. C. Bolland, B.A.
Director of Horticulture.	*T. W. Brown, F.L.S.
Assistant Director -	*F. G. Walsingham.
,, ,,	*G. S. Crouch.

Gold Coast.—Agricultural Department :—

Director of Agriculture.	W. S. D. Tudhope.
Assistant Director and Mycologist.	R. H. Bunting.
Travelling Instructor	*Alfred E. Evans.
Agriculturist - -	H G. S. Branch.
Senior Curator - -	*A. C. Miles.
,, ,, - -	C. Saunders.
,, ,, - -	*A. B. Culham.
,, ,, - -	*T. Hunter.
Curator - - -	M. D. Reece.
,, - - -	*G. H. Eady.
,, - - -	*E. W. Morse.
Conservator of Forests -	N. C. McLeod.

Nigeria.—

Southern Provinces.—Agricultural Department :—

Director of Agriculture.	*W. H. Johnson, F.L.S.
Assistant Director -	A. H. Kirby, B.A.
Mycologist- - -	†C. O. Farquharson, M.A.
Superintendent of Agriculture.	S. V. Henderson.
,, ,,	*F. Evans, F.L.S.
Assistant Superintendent.	*R. Gill.
,, ,,	A. J. Findlay, M.A., B.Sc.
,, ,,	H. G. Burr, B.Sc.
Curator - - -	*A. R. Bell.
,, - - -	*C. Warren.
Chief Conservator of Forests -	H. N. Thompson.

Northern Provinces.—Agricultural and Forestry Department :—

Director of Agriculture.	P. H. Lamb.
Assistant Superintendent.	R. Nicol.
,, ,,	K. T. Rae.
,, ,,	T. Thornton.
,, ,,	†A. Wainwright.
,, ,,	T. Laycock.
Senior Conservator of Forests.	*E. W. Foster.

Nyasaland Protectorate.—

Zomba.—Agricultural and Forestry Department :—

Director of Agriculture.	J. S. J. McCall.
Agriculturist - -	*E. W. Davy.
,, - -	J. Jennings.
,, - -	A. P. Cliff.
,, - -	D. M. Archdale.
,, - -	H. Munro.
Chief Forest Officer -	*J. M. Purves.

Rhodesia.—

Bulawayo.—Rhodes Matopos Park :—

Curator - - -	W. E. Dowsett.

Salisbury.—Department of Agriculture :—

Director - - -	E. A. Nobbs, Ph.D., B.Sc.
Agriculturist and Botanist.	H. G. Mundy, F.L.S.

Sierra Leone.—Agricultural Department :—

Director of Agriculture.	D. W. Scotland.
Assistant Director -	J. M. Watt.
Conservator of Forests -	*K. G. Burbridge (Acting.)

Soudan.—

Khartoum	-	Director of Agriculture and Forests.	Major E. B. Wilkinson.
		Superintendent of Palace Gardens.	*F. S. Sillitoe.
Jebelin	- -	Superintendent of Experimental Plantations.	*T. Cartwright.

Uganda.—

Kampala—Agricultural Department :—

Director of Agriculture.		S. Simpson, B.Sc.
Botanist - - -		†W. Small, M.A., B.Sc.
District Agricultural Officer.		E. T. Bruce.
,,	,,	A. R. Morgan.
,,	,,	L. Hewett.
,,	,,	R. G. Harper.
,,	,,	*T. D. Maitland.
Assistant	,, -	*J. D. Snowden.

Entebbe—Botanical, Forestry and Scientific Department :—

Chief Forestry Officer	——
Assistant - - -	*Robert Fyffe.
,, - - -	W. Howells.

Zanzibar	- -	Director of Agriculture.	F. C. McClellan, F.L.S.
		Assistant Director -	Robert Armstrong.

AUSTRALIA.

New South Wales.—Botanic Gardens :—

Sydney - -	Director and Government Botanist.	-	J. H. Maiden, I.S.O., F.R.S., F.L.S.
	Superintendent	-	E. N. Ward.
	Botanical Assistant	-	E. Cheel.
	,, ,,	-	A. A. Hamilton.
	,, ,,	-	W. F. Blakeley.
	University Professor of Botany	-	A. Anstruther Lawson, D.Sc., Ph.D., F.L.S.
	Technological Museum :—		
	Curator - -	-	R. T. Baker, F.L.S.
	Director of Forests - -	-	R. D. Hay.

Queensland.—

Brisbane.—Botanic Gardens :—			
	Government Botanist	-	C. T. White (Acting).
	Curator - -	-	E. W. Bick.
	Acclimatisation Society's Gardens :—		
	Secretary - -	-	L. G. Corrie, F.L.S.
	Manager - -	-	R. W. Peters.
	Forest Department :—		
	Director - -	-	N. W. Jolly, B.A., B.Sc.
Cairns.—Instructor in Tropical Agriculture.			——
	Kamerunga State Nursery :—		
	Manager - -	-	C. E. Wood.
Rockhampton -	Superintendent -	-	R. Simmons.

South Australia.—

Adelaide.—University Professor of Botany.			T. G. B. Osborn, M.Sc.
	Botanic Gardens :—		
	Director - -	-	J. F. Bailey.
	Woods and Forests :—		
	Conservator - -		Walter Gill, F.L.S.

Northern Territory.—

Port Darwin.—Botanic Gardens :—			
	Curator - -	-	*C. E. F. Allen.

Tasmania.—

Hobart - -	Government Botanist		Leonard Rodway, C.M.G.
	Chief Forests Officer	-	J. C. Penny.
	Botanic Gardens :—		
	Superintendent	-	J. Wardman.

Victoria.—

Melbourne.—Botanic Gardens :—			
	Director - -	-	J. Cronin.
	National Herbarium :—		
	Government Botanist and University Professor of Botany.		A. J. Ewart, D.Sc., Ph.D., F.L.S.
	Conservator of Forests - -	-	H. R. Mackay.

Western Australia —

Perth.—Department of Agriculture :—

Botanist and Pathologist.	F. Stoward, D.Sc.

Department of Woods and Forests :—

Inspector General -	C. E. Lane Poole.

BERMUDA.

Agricultural Department :—

Director - - - - -	E. J. Wortley, F.C.S.

CANADA.

Ottawa - -	Director of Government Experimental Farms.	J. H. Grisdale.
	Dominion Horticulturist.	W. T. Macoun.
	Dominion Botanist -	——
	Assistant - - -	J. Adams.
	,, - - -	F. Fyles, B.A.

CEYLON.

Peradeniya.—Department of Agriculture :—

Director of Agriculture - - -	†F. A. Stockdale, M.A., F.L.S.
Botanist and Mycologist- - -	†T. Petch, B.A., B.Sc.
Assistant Botanist and Mycologist -	†G. Bryce, M.A., B.Sc.
Manager, Peradeniya Experiment Station.	——
Superintendent of Botanic Gardens	*H. F. Macmillan.
Curator of Royal Botanic Gardens, Peradeniya.	*T. H. Parsons.
Curator, Hakgala Gardens - -	*J. J. Nock.
Conservator of Forests - - -	H. F. Tomalin.

CYPRUS.

Principal Forest Officer - -	A. K. Bovill.
Director of Agriculture - -	W. Bevan.

FALKLAND ISLANDS.

Government House Garden :—

Head Gardener - - - - -	*A. W. Benton.

FIJI.

Superintendent of Agriculture and Curator, Botanic Station.	Hon. Charles H. Knowles, B. Sc.

HONG KONG.

Botanic and Forestry Department :—

Superintendent - - - -	*W. J. Tutcher, F.L.S.
Assistant Superintendent - - -	*H. Green.

MALTA.

Inspector of Agriculture - - -	Francesco Debono, M.D.
Superintendent of Public Gardens -	J. Borg, M.D.

MAURITIUS.

Reduit.—Department of Agriculture :—

Director - - - - -	H. A. Tempany, B.Sc., F.I.C., F.C.S.
Assistant Director - -	†G. G. Auchinleck, B.Sc.
Agricultural Instructor -	*F. Birkinshaw.

Pamplemousses.—Department of Forests :—

Director - - - - - -	Paul Koenig.

NEW ZEALAND.

Dunedin - -	Superintendent - -	*D. Tannock.
Napier - -	„ - -	W. Barton.
Auckland -	Ranger - - -	William Goldie.
Christchurch -	Head Gardener - -	J. Young.

SEYCHELLES.

Botanic Station :—

Curator - - - - - -	P. R. Dupont.

STRAITS SETTLEMENTS.

Straits Settlements.—Botanic Gardens :—

Singapore -	Director - - -	†I. H. Burkill, M.A., F.L.S.
	Assistant Director -	*T. F. Chipp, B.Sc., F.L.S.
	Assistant Curator -	——

Federated Malay States.—Forest Department :—

Conservator - -	G. E. S. Cubitt.

Federated Malay States—*continued.*

Kuala Lumpur.—Agricultural Department :—

Director of Agriculture.	L. Lewton-Brain, B.A., F.L.S.
Chief Agricultural Inspector.	†F. W. South, B.A.
Assistant Inspector -	F. Norris.
" " -	A. G. G. Ellis.
" " -	P. B. Richards.
" " -	†H. W. Jack, B.A., B.Sc.
Agriculturist - -	†F. G. Spring, F.L.S.
Assistant Agriculturist	B. Bunting.
Mycologist - -	†A. Sharples.
Assistant Mycologist -	†W. N. C. Belgrave, B.A.
Economic Botanist -	†G. E. Coombs, B.Sc.
Superintendent Government Plantations.	*J. N. Milsum.

Perak (Taiping).—Government Gardens and Plantations :—

Superintendent - -	L. M. Berenger.

Selangor and Negri Sembilan.—

Superintendent - -	*J. Lambourne.

WEST INDIES.

Imperial Department of Agriculture :—

Barbados - -	Commissioner - -	Sir Francis Watts, K.C.M.G., D.Sc., F.I.C., F.C.S.
	Scientific Assistant -	W. R. Dunlop.
	Mycologist and Agricultural Lecturer.	W. Nowell, B.A., B.Sc.
Antigua.—Government Chemist and Superintendent of Agriculture, Leeward Islands.		A. E. Collens, F.C.S. (Acting).

Botanic Station :—

Curator - - -	*T. Jackson.
Agricultural Assistant	A. W. Gallwey (Acting)
" "	V. Pereira "

Barbados.—Department of Agriculture :—

Superintendent -	J. R. Bovell, I.S.O., F.L.S., F.C.S.
Assistant Superintendent.	J. S. Dash, B.Sc.

Dominica.—Botanic Station :—

Curator - -	*Joseph Jones.
Assistant Curator and Assistant Chemist.	G. A. Jones.

Grenada.—Botanic Garden :—

Agricultural Superintendent.	*J. C. Moore.
Agricultural Instructor	W. N. M. Smith.

Montserrat.—Botanic Station :—

Curator - - -	*W. Robson.

St. Kitts-Nevis.—Botanic Station :—

Agricultural Superintendent.	F. R. Shepherd.
Agricultural Instructor, Nevis.	W. I. Howell.

St. Lucia.—Botanic Station :—

Agricultural Superintendent.	*A. J. Brooks, F.L.S., F.C.S.
Overseer - - -	R. W. Niles.

St. Vincent.—Botanic Station :—

Agricultural Superintendent.	*W. N. Sands, F.L.S.
Assistant Agricultural Superintendent.	S. C. Harland, B.Sc.

Virgin Islands.—Botanic Station :—

Curator - - -	*W. C. Fishlock.

British Guiana.—Department of Science and Agriculture :—

Georgetown -	Director - - -	Prof. J. B. Harrison, C.M.G., M.A., F.I.C., F.C.S.
	Assistant Director and Government Botanist.	†C. K. Bancroft, M.A., F.L.S.
	Horticultural Superintendent.	E. M. Peterkin.
	Assistant Gardener -	F. Greeves.
	Agricultural Superintendent.	*Robert Ward.
	Forestry Officer - -	——

British Honduras.—Botanic Station :—

Curator - - -	Eugene Campbell.

Jamaica.—Department of Agriculture :—

Director - - -	Hon. H. H. Cousins, M.A., F.C.S.
Travelling Instructor	*William Cradwick.
" "	James Briscoe.

Public Gardens and Plantations :—

Superintendent -	*William Harris, F.L.S.
Superintendent of Experiment Station.	P. W. Murray.

Tobago.—Botanic Station :—

Curator - - - - -	——

Trinidad.—Department of Agriculture :—

Director - - -	W. G. Freeman, B.Sc., F.L.S. (Acting).
Assistant Director and Government Botanist.	——
Curator, Royal Botanic Gardens.	*R. O. Williams.
Horticulturist and Assistant Botanist.	*W. E. Broadway.
Mycologist, Board of Agriculture.	J. B. Rorer, M.A.
Forest Officer - - -	C. S. Rogers.

INDIA.

Botanical Survey of India :—

Director - - - - -	Major A. T. Gage, I.M.S., M.A., M.B., B.Sc., F.L.S.
Economic Botanist - - -	†H. G. Carter, M.B., Ch.B.
Assistant for Phanerogamic Botany	M. S. Ramaswami, M.A.
,, ,, ,,	P. M. Debburman, B.Sc.

Departments of Agriculture, Botanical Officers attached to :—

Imperial Agricultural Research Institute, Pusa, Bengal :—

Mycologist - - - -	†E. J. Butler, M.B., F.L.S.
Assistant Mycologist - -	F. J. F. Shaw, B.Sc., F.L.S.
Economic Botanist - -	A. Howard, C.I.E., M.A., F.L.S.
Supernumerary Botanist -	——

Bengal Agricultural Department, Calcutta :—

Economic Botanist - -	G. P. Hector, M.A., B.Sc.

Bihar and Orissa :—

Economic Botanist and Principal Sabour, Agricultural College.	E. J. Woodhouse, M.A., F.L.S.

Bombay Agricultural Department, Poona :—

Economic Botanist - -	†W. Burns, D.Sc.

Central Provinces Agricultural Department, Nagpur :—

Economic Botanist - -	†R. J. D. Graham, M.A., B.Sc.

Departments of Agriculture, Botanical Officers attached to—*continued.*

Madras Agricultural Department:—

Government Sugarcane Expert, Agricultural College, Coimbatore.	†C. A. Barber, M.A., Sc.D., F.L.S.
Lecturing Botanist - -	K. Rangachari, M.A.
Mycologist - - - -	†W. McRae, M.A., B.Sc., F.L.S.

Punjab Agricultural Department, Lyallpur:—

Economic Botanist - -	†D. Milne, B.Sc.

United Provinces Agricultural Department, Cawnpur:—

Economic Botanist - -	†H. M. Leake, M.A. F.L.S.

BENGAL.

Calcutta.—Royal Botanic Garden, Sibpur:—

Superintendent - - - -	Major A. T. Gage, I.M.S., M.A., M.B., B.Sc., F.L.S.
Curator of Herbarium - - -	†C. C. Calder, B.Sc., F.L.S.
Curator of Garden - - -	*G. T. Lane.
1st Overseer - - - - -	N. Mitra.
2nd Overseer - - - - -	M. Jones.
Probationer - - - - -	*G. B. Mould.

Gardens in Calcutta:—

Assistant Curator - - - -	*P. V. Osborne.
Overseer - - - - -	S. N. Bose.

Agri-Horticultural Society of India:—

Secretary - - - - -	S. P. Lancaster.

Darjeeling.—Lloyd Botanic Garden:—

Superintendent - - - -	Major A. T. Gage, I.M.S., M.A., M.B., B.Sc. F.L.S.
Curator - - - - - -	*G. H. Cave.

Cinchona Department.—

Superintendent of Cinchona Cultivation.	Major A. T. Gage, I.M.S., M.A., M.B., B.Sc., F.L.S.

Mungpoo Plantation:—

Manager - - - - - -	*P. T. Russell.
1st Overseer - - - - -	P. Cresswell.
2nd Overseer - - - - -	James Hulbert.

Munsong Plantation:—

Manager - - - -	*H. F. Green.
Assistant Manager - - - -	*H. Thomas.
Overseer - - - - -	G. Holl.

Dacca (Ramna).—

Arboricultural Adviser to Govern- *R. L. Proudlock.
ment of Bengal.

BOMBAY.

Bombay City.—Municipal Garden :—

Superintendent - - - - C. D. Mahaluxmivala

Ghorpuri.—Botanic Garden :—

Superintendent - - - - P. G. Kanetkar.

Poona.—Government Gardens :—

Superintendent - - - - *E. Little.

CENTRAL PROVINCES.

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